

FINAL

**INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION REPORT
SITE 2 - PESTICIDE PIT BURIAL AREA**

**STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK**

VOLUME I OF II

SEPTEMBER 1997



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Prepared By

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LIST OF ACRONYMS/ABBREVIATIONS

ABB	ABB Environmental Services, Inc.
ANG	Air National Guard
ANGRC	Air National Guard Readiness Center
ANGSIP	Air National Guard Site Investigation Protocol
Aneptek	Aneptek Corporation
ARARs	Applicable or Relevant and Appropriate Requirements
atm-m ³ /mol	atmospheres-cubic meters per mole
ASTM	American Society for Testing and Materials
AW	Airlift Wing
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BRA	Baseline Risk Assessment
BEHP	bis(2-ethylhexyl)phthalate
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CaCO ₃	Calcium Carbonate
CAGs	Carcinogen Assessment Group
CDI	Chronic Daily Intake
CFR	Code of Federal Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
cm/sec	centimeters per second
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CRQL	Contract Required Quantitation Limit
CWA	Clean Water Act
DDD	4,4'-dichlorodiphenyldichlorethane
DDE	4,4'-dichlorodiphenyldichlorethylene
DDT	4,4'-dichlorodiphenyltrichlorethane
DERP	Defense Environmental Restoration Program
DNAPL	Dense Non-Aqueous Phase Liquid
DoD	Department of Defense
DOT	Department of Transportation
DQO	Data Quality Objective
DWQS	Drinking Water Quality Standard
Dynamac	Dynamac Corporation
eV	electron-volts
E.C. Jordan	E.C. Jordan Company
Eh	Oxidation Potential
EM	electromagnetic
EPA	Environmental Protection Agency

ER-L	Effects Range - Low
ER-M	Effects Range - Medium
°F	Degrees Fahrenheit
FS	Feasibility Study
f_{oc}	fraction organic carbon
ft	feet
ft/d	feet per day
ft/ft	feet per foot
g/cc	grams per cubic centimeter
GC	Gas Chromatograph
gpm	gallons per minute
GPR	Ground Penetrating Radar
HEAs	Health Effects Assessments
HECs	Hazard Equivalent Concentrations
HI	Hazard Index
HQ	Hazard Quotient
IAP	International Airport
ID	inside diameter
IDL	instrument detection limit
IDW	Investigation Derived Waste
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
K	Hydraulic Conductivity
K_d	Distribution Coefficient
K_{oc}	Organic-Carbon Partition Coefficient
K_{ow}	Octanol-Water Partition Coefficient
LEL	Lower Explosive Limit
LFCSI	Landfill Closure Site Investigation
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
MDL	Method Detection Limit
mg/kg	milligram per kilogram
$\mu\text{g/kg}$	microgram per kilogram
mg/L	milligrams per liter
$\mu\text{g/L}$	micrograms per liter
$\mu\text{g/dL}$	micrograms per deciliter
MHz	Megahertz
ml	milliliter
mm Hg	millimeters of mercury
MOE	Ministry of the Environment
MSA	Method of Standard Additions
msl	mean sea level
MS/MSD	Matrix Spike/Matrix Spike Duplicate

NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NCDC	National Climatic Data Center
ND	Not Detected
NDA	No Data Available
NESHAPS	National Emission Standards for Hazardous Air Pollutants
n_c	effective porosity
NGB	National Guard Bureau
NI	Not Included
NOAA	National Oceanic and Atmospheric Administration
NYANG	New York Air National Guard
NYCRR	New York Code of Rules and Regulations
NYDOH	New York Department of Health
NYDWQS	New York Drinking Water Quality Standard
NYSDEC	New York State Department of Environmental Conservation
OD	outside diameter
oz	ounce
ρ	bulk density
PA	Preliminary Assessment
PAH	Polyaromatic Hydrocarbon
PEST/PCBs	Pesticides and Polychlorinated Biphenyls
PCBs	Polychlorinated biphenyls
PID	Photoionization detector
POC	Principle Organic Compound
ppb	parts per billion
ppm	parts per million
PPBA	Pesticide Pit Burial Area
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
R	Retardation Factor
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RQD	Rock Quality Designations
SARA	Superfund Amendments and Reauthorization Act
SB	Site Background
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act
SEL	Severe Effects Level
SI	Site Inspection
SPDES	State Pollutant Discharge Elimination System
SVOCs	Semi-Volatile Organic Compounds

TAGM	Technical and Guidance Memorandum
TAL	Target Analyte List
TBC	To-Be-Considered
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TICs	Tentatively Identified Compounds
TOC	Total Organic Carbon
TOGS	Technical and Operational Guidance Series
UCL	Upper Confidence Limit
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
$\mu\text{g/L}$	micrograms per liter
V_x	average linear velocity or seepage velocity
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

Background

A Remedial Investigation (RI) of Site 2, the former Pesticide Pit Burial Area (PPBA) at Stewart Air National Guard Base (the Base), was performed by Aneptek Corporation. Site 2 is located southeast of the airport complex at the Stewart International Airport, Newburgh, New York. The site was the location of a now backfilled pit that was used in the late 1960's to dispose of pesticide containers. The pit was approximately 20 feet by 53 feet by 12 feet deep. Site 1 (the former Base landfill) and Site 2 have been the subject of several previous investigations by both the New York State Department of Environmental Conservation (NYSDEC) and the National Guard Bureau. A removal action was performed at Site 2 in 1988, when the pit was excavated and contaminated soils and containers were removed.

Scope of Remedial Investigation. The RI field program included sampling of surface soils, sediments, subsurface soils and groundwater to provide data for a evaluation of site geology and hydrogeology, determination of residual contamination nature and extent, evaluation of contaminant fate and transport, and preparation of a baseline risk assessment and ecological risk characterization. Geophysical surveys were performed to locate the original location of the pesticide burial pit. Subsurface soils were screened in the field for total pesticides by immuno assay methodology to assist in the evaluation of the nature and extent of contamination. Slug tests were performed on monitoring wells to provide estimates of formation hydraulic conductivity. All soil and sediment samples submitted for off-site laboratory analysis were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), metals, cyanide and total organic carbon by New York State Contract Laboratory Program methods. Groundwater was analyzed for these same parameters with the exception of total organic carbon.

Investigation Findings

Geology. Site 2 is underlain by an approximately 45 foot thick layer of very dense silty to clayey lodgement glacial till derived from the underlying bedrock, the shallow portion of which has been weathered to less dense soil. Bedrock immediately underlying the till is composed of weathered, fractured, dark grey shale, with competency increasing with depth.

Hydrogeology. Groundwater flow in the study area can be separated into two interconnected flow systems, an upper flow system in the overburden and a lower system in the underlying weathered, fractured shale bedrock. The lodgement till appears to impede vertical flow, especially beneath Site 2, where the unweathered portion of the till is very thick (greater than 20 feet).

Groundwater flows in both the overburden and bedrock to the east or east-southeast towards lower topographic elevations. In the overburden, groundwater flow originating from the vicinity of Site 2 discharges to the wetlands associated with Murphy's Gulch. In the bedrock, a

southeastern component of flow not observed in the overburden indicates that groundwater in the bedrock originating from Site 2 appears to flow to the southern portion of the study area. In addition, radial flow indicated by the bedrock groundwater elevations in the vicinity of Site 2 was observed, possibly induced by less dense backfill and surface runoff detention in the PPBA which results in locally increased infiltration, causing a localized "mounding" condition. In most cases, vertical gradients were strongly downward in the vicinity of Site 2. Strongly upward gradients were observed only in the vicinity of the wetlands west of Murphy's Gulch suggesting groundwater discharges to surface waters east of Site 2.

In the overburden, average horizontal linear or seepage velocity estimates range from 0.21 to 0.64 feet per day (ft/d). In the bedrock, estimates range from 0.30 to 2.42 ft/d. These estimates are based on a geometric mean hydraulic conductivity estimate in the overburden of 0.35 ft/d (1.23×10^{-4} cm/sec) and 0.22 ft/d (7.84×10^{-5} cm/sec) in the fractured bedrock. The relatively high average horizontal linear velocity estimates are due to both the high observed horizontal gradient and the relatively low formation effective porosity of 1 to 10 percent in the overburden and 1 to 8 percent in the bedrock. Because vertical hydraulic conductivity may be lower than horizontal hydraulic conductivity by one to two orders of magnitude, corresponding average vertical linear velocity would be correspondingly lower, since both vertical and horizontal hydraulic gradients exhibited similar values.

Nature and Extent of Residual Contamination. Surface soils were generally free of significant contamination. The compounds exceeding site background or NYSDEC Cleanup Goals were manganese and chromium. No surface soil samples contained pesticide concentrations greater than their respective NYSDEC Cleanup Goals. The lateral extent of residual pesticide contamination within subsurface soils was well defined to the north, south, and west of the PPBA. The bulk of residual subsurface soil contamination appears to be present approximately 15 to 25 feet below ground surface (bgs) in the vicinity of soil boring MW-02. Several inorganic analytes were detected at concentrations greater than their respective background or NYSDEC Cleanup Goals. The majority of these detections were found at the overburden/bedrock interface in soil borings SB-06 and MW-02. No discernible pattern of elevated concentrations of inorganic analytes was found in subsurface soils.

Every sediment sample contained low levels of pesticides. Exceedances of NYSDEC Cleanup Goals were found only in samples SS-04 and SS-06, in the vicinity of the ponded area. Inorganic analytes exceeding NYSDEC Cleanup Goals were found in several samples, but the highest levels were found in SS-05, located within the ponded area.

Groundwater in the vicinity of Site 2 is generally free of significant VOC and SVOC contamination. However, pesticides were detected in all groundwater samples, thus exceeding the State drinking water pesticide standard which requires the presence of no detectable level. Therefore, the full extent of pesticide contamination in groundwater has not been defined. To the east of Site 2, groundwater pesticide concentrations decreased by an order of magnitude over a distance of approximately 540 feet, from SW-2 to MW-09. To the west, the only well is MW-01. In addition, several inorganic compounds were detected at concentrations greater than

drinking water standards. However, due to the absence of site-specific background data for inorganics, it is not possible to determine if these detections are actually elevated or if they are representative of site background concentrations.

Contaminant Fate And Transport. Adsorption to organic material and fines in the overburden appears to play a major role in the inhibition of substantial organic contaminant migration from the source area. The primary organic contaminants of interest, the pesticides 4,4'-DDT, 4,4'-DDE and 4,4'-DDD, have very low solubilities, very high sorption potential and high retardation factors. They are migrating through the bedrock aquifer with no substantial biodegradation or volatilization at concentrations at or below their solubility limits. Detected VOCs and SVOCs are also strongly inhibited by adsorption processes and are not expected to migrate any substantial distance from the source area. Although vinyl chloride, a biodegradation breakdown product of chlorinated solvents, was detected in groundwater, it was found only downgradient of the landfill. None of its parent compounds were detected in the source area, thus vinyl chloride is not thought to be associated with Site 2.

Metals are primarily affected by adsorption processes. With the exception of iron, the metals detected in groundwater are those that would be expected to be found in solution under the known conditions of dissolved oxygen, pH and Eh. Most metals found in soils and sediment are expected to remain sorbed unless substantial changes in aquifer pH or redox conditions occur.

Flow path analysis indicates that whether contaminants migrate via surface runoff or through groundwater, the ultimate transport destination appears to be the wetlands and surface water of Murphy's Gulch, located topographically and hydrologically downgradient of Site 2.

DDT, the primary pesticide contaminant of interest, was usually prepared in two liquid forms, an emulsion in water or as a solute in acetone, kerosene or fuel oil. Given this information, the pesticide and its liquid carrier would not have migrated any substantial distance from the pesticide pit in its pure form, due to the density and fine-grained nature of the lodgement till soils. Because there is no evidence of any residual Light Non-Aqueous Phase Liquid (LNAPL) in the overburden or the bedrock in the vicinity of the Site 2, it is likely that any carrier solvent has volatilized, biodegraded or dissolved to nearly undetectable levels. The presence of trace levels of the VOC ethylbenzene and phenolic SVOCs that are associated with petroleum products such as kerosene or fuel oil, in some groundwater samples from SW-02 (located nearby Site 2) supports this idea.

Risk Assessment

Human Health Risk Evaluation. The human health risk assessment indicated that the risks for all current site receptors are within or below the EPA targets. The total hazard index for current site uses is 0.02, which is well below the EPA target of 1.0. The total cancer risks for the current site uses is 7×10^{-6} , which is within the EPA target range of 1×10^{-4} to 1×10^{-6} .

In addition, the risks for all future receptors, with the exception of future residents, are within or below the EPA targets. The hazard indices for all future receptors, with the exception of the future residential scenario, are well below the EPA target of 1.0. The hazard index for site workers is 0.01, the hazard index for area residents is 0.007, and the hazard index for construction workers is 0.01.

The only exposure scenario with unacceptable risks is the future residential scenario. The hazard index for future on-site residents is 23, almost all of which is attributable to groundwater (hazard index = 23). The breakdown of the cancer risks is similar. Cancer risks for the on-site worker (5×10^{-6}), construction worker (3×10^{-6}), and area resident (2×10^{-6}) are all within the EPA target range of 1×10^{-4} to 1×10^{-6} . The cancer risk for the future on-site resident is 2×10^{-3} , almost all of which is attributable to ingestion of and dermal contact to groundwater.

A number of extremely conservative exposure assumptions were used throughout the risk assessment process. For example, based on current plans for the Base, and the availability of city water to the area, it is highly unlikely that Site 2 will be used for residential purposes, and even more unlikely that a drinking water well would be located at the site. In addition, all exposure point concentrations and risk estimates were derived using values which tended to be conservative. Therefore, it is likely that the risks are highly overestimated and that actual site risks would be much lower.

Ecological Risk Evaluation. The ecological risk characterization indicates that of the analytes detected in sediment samples, the polyaromatic hydrocarbon (PAH) benzo(g,h,i)perylene (detected in SS-04), the pesticides DDT and DDE (detected in SS-04 and SS-06), and manganese (detected in all samples), exceeded applicable sediment criteria guidelines and background levels used as screening values for sediment. These criteria guidelines were developed for the protection of benthic organisms inhabiting aquatic environments. However, the site environment does not provide valuable aquatic habitat, due to the intermittent nature of storm water discharges within the drainage ditches. Therefore, the ecological risks caused by these substances is considered less significant than the poor quality of the habitat itself. It should be noted that all concentrations detected in sediment samples were well below New York State cleanup criteria for soil.

Recommendations

No further action is recommended at Site 2, because of the fact that the unacceptable risks associated with detected contaminants are attributable only to a future residential scenario that is highly unlikely given the current and planned future uses of the area. Site 2 is located less than 100 feet from Site 1, the former Base landfill, which is to be capped. The deed restrictions associated with the landfill cap will effectively prevent future residential use of Site 2, thus mitigating any potential risk associated with future use of Site 2.

SECTION 1.0

1.0 INTRODUCTION

This report presents the results of a Remedial Investigation (RI) performed at Installation Restoration Program (IRP) Site Number 2 (Site 2), the Pesticide Pit Burial Area (PPBA) at the 105th Airlift Wing (AW), New York Air National Guard (ANG) Base located at Stewart International Airport (IAP), in the towns of both Newburgh and New Windsor, New York. The Air National Guard Readiness Center (ANGRC) tasked Aneptek Corporation (Aneptek) to perform the Remedial Investigation/Feasibility Study (RI/FS) of Site 2 under National Guard Bureau (NGB) Contract No. DAHA90-93-D-0003, Delivery Order No. 004.

The RI program was initiated at a scoping/kick-off meeting held at Stewart ANG Base (the Base) on October 24, 1994, which was attended by officials from ANGRC, the 105th Airlift Wing, the New York State Department of Environmental Conservation (NYSDEC) and Aneptek. At the meeting, regulatory requirements, planning, logistics and responsibilities were defined. Subsequently, Aneptek submitted an RI Work Plan, which was approved by ANGRC and NYSDEC, on August 17, 1995, and initiated RI field work during August, 1995. The RI field program was completed during April, 1996.

1.1 Objectives

The purpose of this RI was to characterize the nature, extent and risk associated with residual contamination at Site 2, which is located southeast of the airport complex. The site was the location of a now backfilled pit that was used in the late 1960's to dispose of pesticide containers. The pit was approximately 20 feet by 53 feet by 12 feet deep. Site 2 and adjacent Site 1 (the former Base landfill) have been the subject of several previous investigations including an investigation performed by NYSDEC, Step I and II investigations, a removal action and a Site Investigation performed by the NGB. Summaries of these previous investigations are provided in Section 2.0.

1.2 Scope and Methodology

The RI field program included electromagnetic (EM) and ground penetrating radar (GPR) geophysical surveys to identify the PPBA, the advancement of nine soil borings in the vicinity of the PPBA, the installation of four groundwater monitoring wells, in-situ aquifer testing of the wells, and the collection of surface soil, subsurface soil, sediment, and groundwater samples for chemical analysis. All surface soil, sediment, and groundwater samples were submitted to an off-site laboratory for chemical analysis for Target Compound List (TCL) Volatile Organic Compounds (VOCs), TCL Semivolatile Organic Compounds (SVOCs), Pesticides and polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals and cyanide in accordance with New York State Contract Laboratory Program (CLP) Protocols. All soil samples were also analyzed for Total Organic Carbon (TOC). All subsurface soil samples collected were field screened for total VOCs and total pesticides. An HNu[®] Photoionization Detector (PID) was

used to screen for total VOCs and an immuno assay test was used to screen for pesticides. Two samples from each soil boring were submitted to the offsite laboratory for chemical analysis for the full TCL/TAL list of parameters, also in accordance with New York State CLP Protocols. The samples selected were the samples with the highest field screening levels, as well as the deepest sample collected.

1.3 Report Format

This RI report is divided into eleven sections. Section 1.0 describes the objective and general methodology of the RI, as well as the IRP program approach. Section 2.0 provides background information pertaining to the Site and the results of previous investigations. Section 3.0 describes the environmental setting of the Base. Section 4.0 identifies regulatory Applicable or Relevant and Appropriate Requirements (ARARs). Section 5.0 describes the RI field program. Section 6.0 presents the investigation results including the physical characterization of the site and nature and extent of contamination. Section 7.0 is a discussion of contaminant fate and transport. Section 8.0 presents the human health and ecological baseline risk assessments. Sections 9.0 and 10.0 present conclusions and recommendations, respectively. References are listed in Section 11.0. Supplemental information obtained during the SI is presented in several appendices, as follows:

- Appendix A Basewide Site Investigation Data
- Appendix B Field Change Requests
- Appendix C Investigation Derived Waste
- Appendix D Boring Logs
- Appendix E Monitoring Well Construction Logs
- Appendix F Water Level Data and Calculations
- Appendix G Aquifer Testing Data and Analyses
- Appendix H Geophysical Survey Reports
- Appendix I Pesticide Screening Data
- Appendix J Chains of Custody
- Appendix K Analytical Data
- Appendix L Data Validation Reports
- Appendix M Results of EPA's Biokinetic Uptake Model For Lead
- Appendix N Letters From NYSDEC Regarding Sensitive Habitats and Water Bodies

1.4 Installation Restoration Program Approach

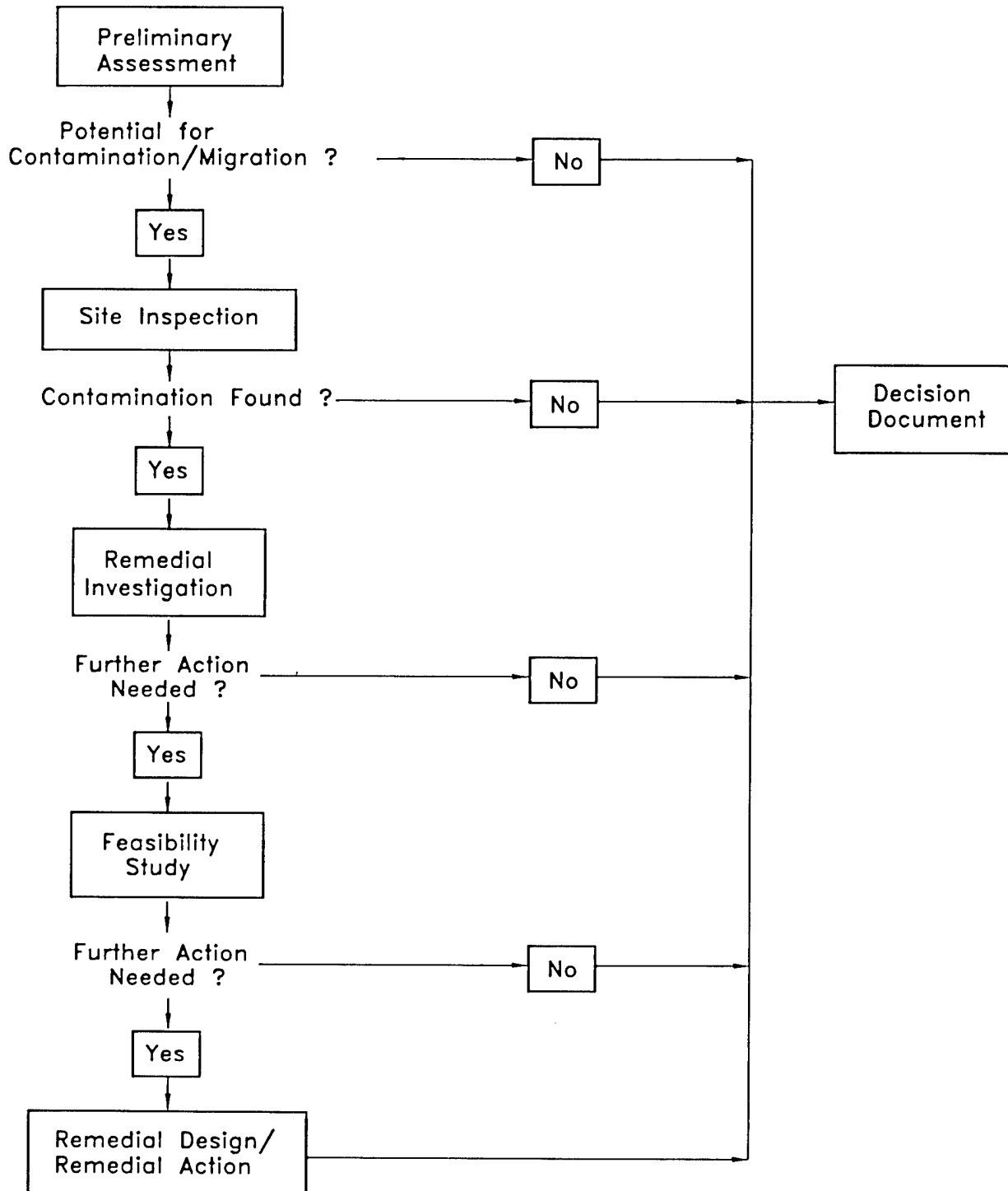
This RI was performed as part of the IRP program to comply with the Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA), and the Superfund Amendments and Reauthorization Act (SARA). The ANGRC manages the IRP and related activities at ANG Installations. The IRP was established under the Defense Environmental Restoration Program (DERP), which was instituted in 1984 to promote and coordinate efforts for the evaluation and cleanup of contamination at Department of Defense (DoD) installations. On January 23, 1987, Presidential Executive Order 12580 was issued which assigned the

responsibility to the Secretary of Defense for carrying out DERP within the overall framework of CERCLA and SARA. The IRP was authorized to investigate and cleanup contamination associated with past DoD activities to ensure that threats to public health are eliminated and to restore natural resources for further use.

The primary objectives of the IRP are: (1) to identify and evaluate former spill and waste disposal sites at DoD facilities, and (2) to remediate all sites that pose a threat to public health, welfare, or the environment. When contamination is identified, its nature and extent are evaluated and remedial action is implemented. The IRP emphasizes cooperation with state and federal environmental regulatory agencies and with the public through community relations planning.

The IRP consists of several tasks, each with specific work elements designed to flow from site characterization through development and implementation of remedial alternatives as shown on the IRP Flow Chart (Figure 1-1). The chart identifies the key decision points in the process. The major IRP tasks and goals are listed below, in the order in which they are performed.

- **Preliminary Assessment (PA):** The goal of the PA is to identify sites which require further investigation or remediation.
- **Site Inspection (SI):** The major goal of an SI is to confirm the presence or absence of contamination and other site characteristics.
- **Remedial Investigation:** The goal of the RI is to fully characterize the nature and extent of contamination at the site as well as to obtain sufficient data to determine the need for site remediation and to accurately evaluate remedial alternatives. The performance of a Baseline Risk Assessment (BRA) is often part of the RI. The BRA evaluates the risks to human health and the environment under existing site conditions and provides the basis for determining the need for site remediation.
- **Feasibility Study:** The goal of the FS is to define and evaluate a range of remedial alternatives (including the no action alternative) and determine the most suitable alternative for the site.
- **Remedial Design and Technical Support:** The goals of the Remedial Design phase is to prepare a remedial design, along with a bid package including drawings and specifications, as appropriate, which will allow the ANG to solicit bids for the remediation.
- **Focused Feasibility Studies/Interim Remedial Measures:** An optional stage in the IRP process is an Interim Remedial Measure, which generally involves a Focused Feasibility Study followed by a limited remedial action. Interim Remedial Measures are implemented when immediate threats to human health and the environment are identified at any step in the IRP process, including the SI or RI.



STEWART AIR NATIONAL GUARD BASE

IRP FLOW CHART

NEWBURGH, NEW YORK



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FIGURE: 1-1

As shown on Figure 1-1, the IRP process can end at any point with a finding of no further action, which would then be outlined in a decision document. The completion of the RI (including the BRA) is a major decision point in the IRP process. If the RI BRA indicates the need for remediation in order to protect human health or the environment, an FS will be conducted. If the RI BRA indicates no risk, a no further action decision document will be prepared. Although the RI and the FS are discussed in an interactive manner, it is understood that the FS portion of the project will not be performed unless warranted by site conditions. An FS can also result in a decision that no further action is needed.

SECTION 2.0

2.0 SITE BACKGROUND

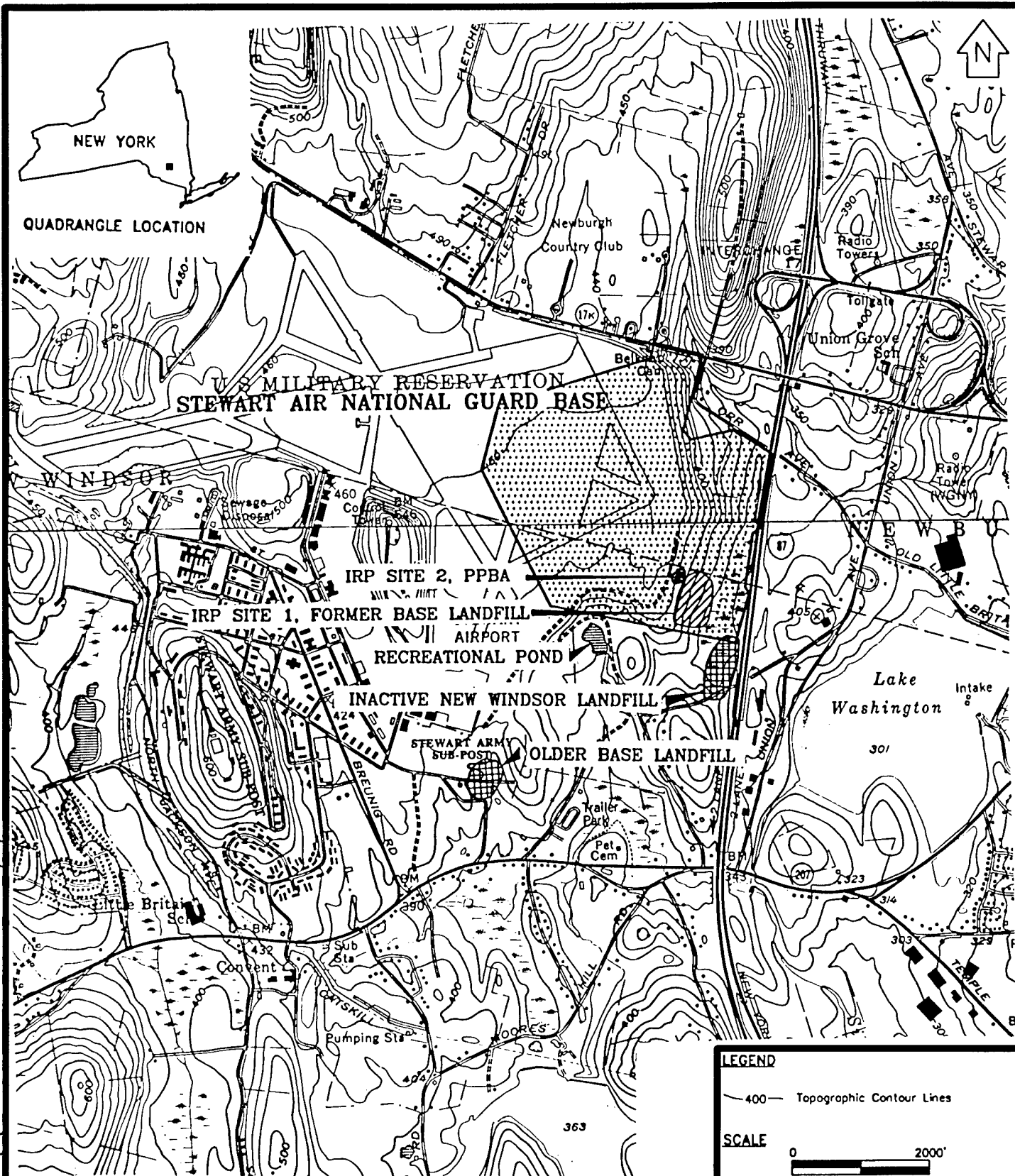
This section presents brief background summaries of the Base (Section 2.1) and the site (Section 2.2), as well as findings from previous investigations (Section 2.3).

2.1 Base Description and History

The Base is located at the Stewart IAP, located 2.5 miles west of the City of Newburgh, New York (Figure 2-1). The airport property occupies approximately 9,800 acres in Orange County, NY and supports landing strips and taxiways as well as the Base facilities. The Base facilities are located in both the Towns of Newburgh and New Windsor, New York. According to the 1990 Census, Orange County had a population of 307,647. The City of Newburgh, the Town of Newburgh, and the Town of New Windsor have populations of 26,454, 24,058, and 22,937, respectively.

Stewart IAP includes a number of landing strips, taxiways and airport support service areas, in addition to the New York ANG Base facilities. The airport facilities are zoned for Industrial usage in the Town of Newburgh, and Airport usage in New Windsor. The ANG Base facilities in Newburgh, NY are bounded on the west and northwest by Industrial Zones, and on the north and east by Interchange Business Zones. In New Windsor, the Base is bounded on the south and southwest by Airport Zones, on the southeast by Planned Industrial Zones, and to the east by Office and Light Industrial Zones. Residential housing is scattered throughout most of these areas (E.C. Jordan Company [E.C. Jordan], 1989).

The Base is located on property that was originally donated to the City of Newburgh in 1930 for use as a municipal airport. Before that time, the majority of the land was used for agricultural purposes. In 1941, a pilot training facility was constructed for cadets at the U.S. Military Academy at West Point. From 1941 to 1969, the U.S. Air Force operated the facility as Stewart Air Force Base out of which B-57, F-100, and C-119 aircraft were flown. The aviation facilities were turned over to the State of New York in 1969. The state of New York has had continuous fee ownership of the property since 1969. Civilian aircraft and U.S. Army C-12 and Helos aircraft were operated and maintained during this time. In 1982 operation of the airfield was taken over by the New York Metropolitan Transit Authority (MTA). From early 1983 to the present, the 105th AW has leased the southeastern corner of Stewart IAP from the New York State MTA. From 1983 to 1985, the unit flew and maintained the Cessna O-2. In July 1985, the 105th AW began flying the C-5A "Galaxy" aircraft. The Base continues to use these aircraft to conduct strategic airlift missions. A small contingent of the U.S. Marine Corps Reserve Airlift Command also uses a section of the Base for its air-refueling missions using the KC-130 "Hercules" aircraft.



STEWART AIR NATIONAL GUARD BASE

SITE LOCATION MAP

NEWBURGH, NEW YORK



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FIGURE: 2-1

2.2 Site Description

Site 2 is located southeast of the airport complex. The site was the location of a now backfilled pit that was used in the late 1960's to dispose of pesticide containers. The pit was approximately 20 feet by 53 feet by 12 feet deep (Dames and Moore, 1986). The location of Site 2 at the Base is shown in Figure 2-2. Site 2 is located adjacent to a main access route on the Base and access is unrestricted. The Stewart ANG Base Environmental Support Office, a softball field, parking areas and a recently-constructed automotive maintenance facility are located close to Site 1 and Site 2.

2.3 Previous Investigations of Site 2

Site 2 was the subject of several previous investigations and one removal action. The following discussion presents a summary of the scope and results of previous activities conducted at Site 2 as well as the data gaps and recommendations of the SI Report (E.C. Jordan, 1989).

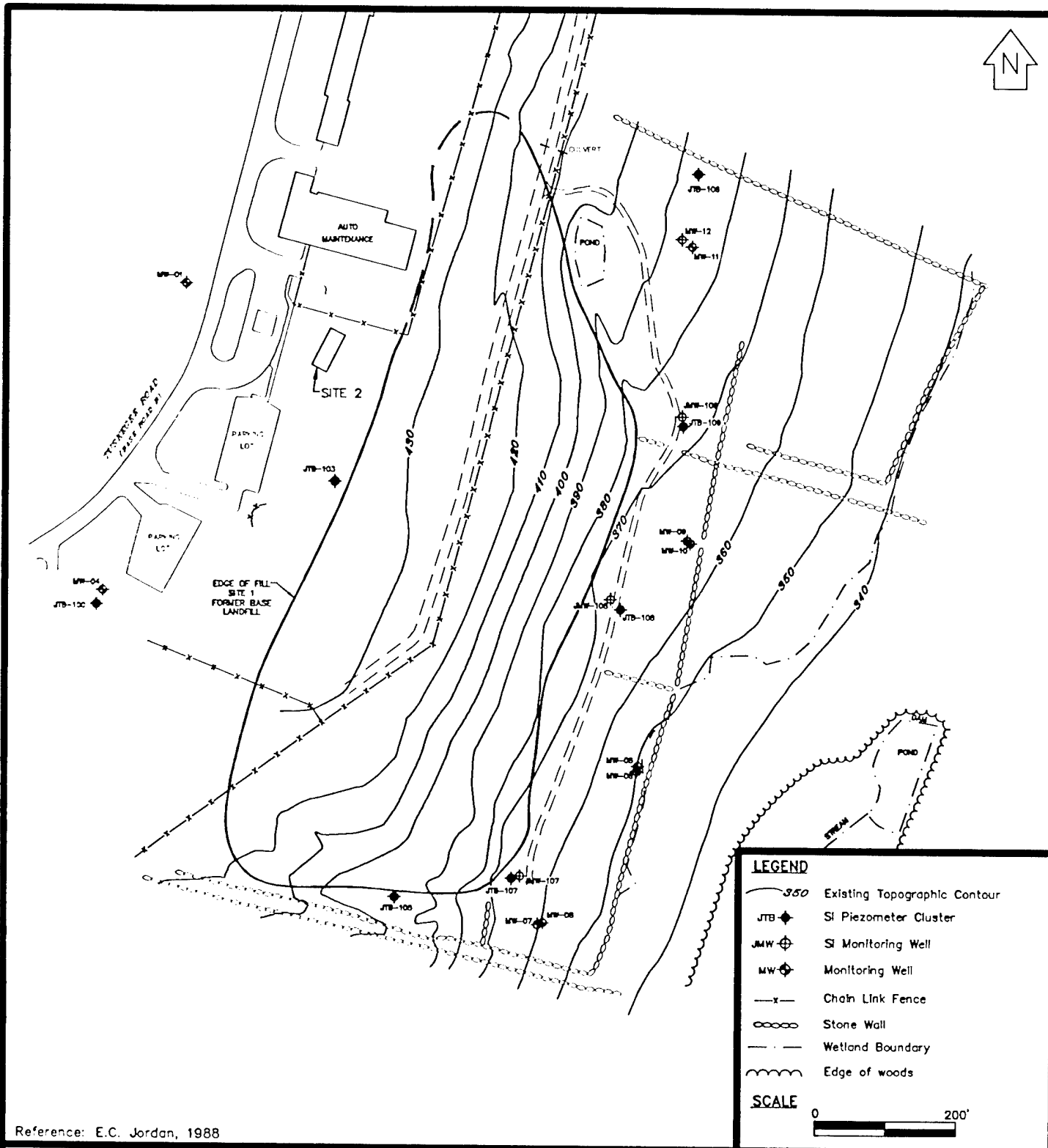
2.3.1 NYSDEC Investigation

The first investigation of Site 2 was performed by NYSDEC in the early 1980's. This investigation was prompted by an anonymous tip regarding the disposal of pesticides. The disposal pit was never actually located during the NYSDEC investigation, which included both ground penetrating radar and test trenching. Later, NYSDEC determined that the investigation covered an area approximately 1,000 feet from the actual location of the pit (Dames and Moore, 1986).

2.3.2 Step I Investigation, Dames and Moore, 1984

In 1984, a Step I Investigation was carried out by Dames and Moore. Dames and Moore was able to locate the burial pit through the use of aerial photographs, a field inspection, a series of metal detector and magnetometer surveys along with a series of test pit excavations. As summarized in the Step 2 Report (Dames and Moore, 1986), they identified a large anomaly in the target area that corresponded to a depression visible in the aerial photographs, along with several smaller anomalies. Domestic refuse was observed in test pits excavated in the large area. Although no pesticide containers were found in the excavations, several buried containers (some labeled "Caution-Acid") were found along the western edge of the investigation area. Based on these findings, the PPBA was estimated to be roughly rectangular, with dimensions of approximately 15 by 25 feet. Figure 2-3 depicts the approximate area of Site 2 as defined by these geophysical surveys and test pit excavation activities.

Dames and Moore collected several soil and liquid samples from the test pits in order to better characterize the waste constituents. The analytical results from these samples are summarized in Table 2-1. Several pesticides were detected in the soil samples, primarily dichlorodiphenyltrichloroethane (DDT) and its breakdown products, dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD).



Reference: E.C. Jordan, 1988

STEWART AIR NATIONAL GUARD BASE LOCATION OF SITE 2

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FIGURE: 2-2

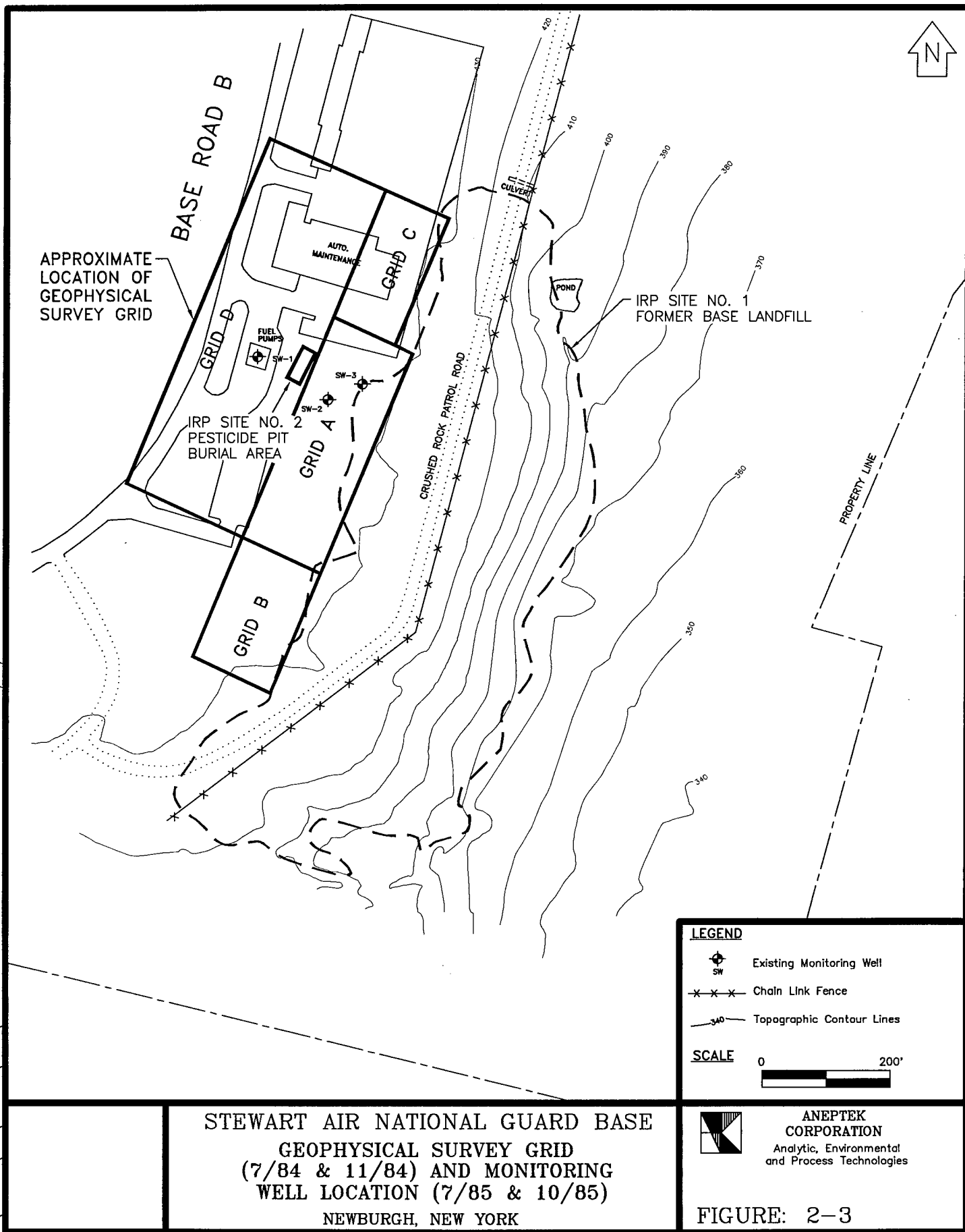


TABLE 2-1
SITE 2 - ANALYTICAL RESULTS FOR TEST PITS
STEP I INVESTIGATION
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER	UNITS	TEST PIT NUMBER					
		TP-3	TP-3 (a)	TP-5	TP-6	TP-7	TP-8
Soil Samples							
Parathion	µg/g	ND	NA	ND	2.2	0.59	3.9
p,p'-DDT	µg/g	13,000	NA	0.17	1700	73	122
o,p'-DDT	µg/g	3900	NA	0.06	60	25	49
DDD	µg/g	3900	NA	ND	950	140	370
DDE	µg/g	ND	NA	ND	130	6.1	7.2
2,4-D	µg/g	0.42	NA	ND	ND	ND	ND
2,4,5-T	µg/g	ND	NA	ND	ND	0.37	0.61
Liquid Samples							
Parathion	µg/L	ND	ND	NA	ND	ND	3.8
p,p'-DDT	µg/L	3,040	370,000	NA	20,000	120,000,000	440
o,p'-DDT	µg/L	950	100,000	NA	16,000	38,000,000	360
DDD	µg/L	7,100	159,000	NA	23,000	28,000,000	430
DDE	µg/L	ND	ND	NA	1,500	4,000,000	37
2,4-D	µg/L	ND	130	NA	6.6	2.2	3
2,4,5-T	µg/L	ND	31	NA	47	5.4	6.6
Heptachlor	µg/L	3.2	ND	NA	ND	ND	ND
Sulfuric acid	mg/L	NA	NA	NA	NA	490	480
Hydrochloric acid	mg/L	NA	NA	NA	NA	7	32
Hydrofluoric acid	mg/L	NA	NA	NA	NA	0.3	2

ABBREVIATIONS

NA = Not analyzed

ND = Value less than limit of detection

µg/g = micrograms per gram

µg/L = micrograms per liter

mg/l = milligrams per liter

Reference: Dames & Moore, 1986

NOTES

(a) Two liquid samples were collected from test pit 3.

2.3.3 Step II Investigation, Dames and Moore, 1985-1986

Dames and Moore followed up the initial investigation with a Step II Investigation conducted in 1985 and 1986. This investigation included the installation of 3 monitoring wells, the collection of subsurface soil samples from the monitoring well borings, and the collection of groundwater samples. The locations of the monitoring wells are shown in Figure 2-3. The results of the Step II analytical program are summarized in Tables 2-2 and 2-3 for soils and groundwater, respectively. The original plan was to install the borings only in the glacial till overburden; however, no groundwater was present in the till, so the borings were extended into the weathered shale bedrock, the first water-bearing zone. Depth to groundwater at Site 2, as measured in October 1985, ranged from 22.4 feet below ground surface (bgs) at SW-03, to 29.6 feet bgs at SW-01.

In general, contaminants were not detected in the soil or groundwater samples from SW-01 and SW-03, with the exception of trace concentrations of p,p'-DDT, 2,4-D, and dieldrin. The samples from SW-02 contained several pesticides. Of the soil samples collected from SW-02, the sample obtained from the weathered shale layer had the higher pesticide concentrations.

Based on the results of the Step II program, Dames and Moore recommended further work, including: an interim removal action to remove the source of the contamination; further investigations to more clearly define groundwater flow at the site and to more clearly delineate the groundwater contamination plume; and, installation of an additional monitoring well.

2.3.4 Removal Action, Dynamac Corporation, 1988

Dynamac Corporation (Dynamac) completed an interim removal action in 1988, as a subcontractor to Geo-Con, Inc. The plan for the removal action was to excavate the pit and dispose the soils, drums, and containers (primarily 5-gallon containers) in a regulated, permitted landfill. The goal was to remove all waste materials and soils containing greater than 10 parts per million (ppm) of DDT. A 20-foot by 53-foot pit was excavated and H-piles were driven to support the walls of the excavation. The piles were driven as deep as possible, with stiff resistance (bedrock or very stiff hardpan material) generally encountered at depths of 22 to 23 feet bgs, or less.

Drums and containers were unearthed in the pit at depths starting at 4 feet bgs. Visual inspection showed that the containers had all been punctured prior to placement in the pit. Little or no liquid was present in the containers. Most of the containers observed were 5-gallon size, though several 55-gallon drums were present. One of the 55-gallon drums appeared to contain used motor oil (Dynamac, 1988). In total, 105, 5-gallon containers and 13, 55-gallon drums were removed, along with some domestic and miscellaneous refuse. Most of the waste was found in the north-central area of the pit (Dynamac, 1988). All of the drums were found at depths of 12 feet or less. Three additional 55-gallon drums were unearthed just beyond the northern boundary of the pit so the original pit was extended northward by about 10 feet to ensure that all the drums had been excavated.

TABLE 2-2
SITE 2 - ANALYTICAL RESULTS FOR SOIL
STEP II INVESTIGATION
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER	UNITS	DETECTION LIMIT	SAMPLE NUMBER			
			SW-1	SW-2-1	SW-2-2	SW-3
Depth	ft.	NA	31	25	35	25
Malathion	ppm	0.01	ND	0.01	ND	ND
Parathion	ppm	0.01	ND	0.08	ND	ND
p,p'-DDT	ppm	0.001	0.001	1.5	8.2	ND
o,p'-DDT	ppm	0.005	ND	0.42	1.9	ND
DDD	ppm	0.001	ND	0.47	2.5	ND
DDE	ppm	0.001	ND	0.026	0.058	ND
2,4-D	ppm	0.005	ND	0.067	0.35	0.022
2,4,5-T	ppm	0.005	ND	0.006	0.040	ND

ABBREVIATIONS

NA = not applicable

ND = not detected

ppm = parts per million

Reference: Dames & Moore, 1986

TABLE 2-3
SITE 2 - ANALYTICAL RESULTS FOR GROUNDWATER
STEP II INVESTIGATION
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER	UNITS	DETECTION LIMIT	WELL NUMBER		
			SW-1	SW-2	SW-3
Dieldrin	ppb	0.01	0.04	ND	ND
Lindane	ppb	0.01	ND	0.03	ND
p,p'-DDT	ppb	0.02	ND	15.0	ND
o,p'-DDT	ppb	0.02	ND	4.4	ND
DDD	ppb	0.02	ND	8.5	ND
DDE	ppb	0.02	ND	0.15	ND
2,4-D	ppb	0.1	ND	20.0	0.1
2,4,5-T	ppb	0.05	ND	0.45	ND

ABBREVIATIONS

ND = not detected

ppb = parts per billion

References: Dames & Moore, 1986

In order to evaluate the success of the removal action, several soil samples were collected from the bottom of the pit. Several of the samples collected from the top 6 inches of soil remaining in the bottom of the pit had DDT concentrations greater than the clean-up goal of 10 ppm of DDT. The soils in the bottom of the pit were too stiff to allow for split-spoon sampling; therefore, soils were sampled from test trenches dug in the bottom of the pit (Dynamac, 1988). The sampling results, shown in Table 2-4, indicated that additional soils would need to be removed. The excavation was extended in several locations, but its total depth did not exceed 21 feet at any location. Most of the additional excavation work was carried out in the northern half of the pit. The final excavation profile is shown in Figure 2-4.

The excavated wastes and soils were then hauled to the Chemical Waste Management Model City Landfill near Buffalo, NY for disposal. The H-piles were dug out, cut at an approximate depth of 10 feet, and placed back in the pit. The pit was backfilled with clean fill material, compacted, and graded to a level appearance (Dynamac, 1988).

2.3.5 Site Inspection, E.C. Jordan, 1988

After completion of the removal action, E.C. Jordan performed a follow-up investigation and an initial assessment of the environmental and public health risks associated with Site 2 in conjunction with their SI at the adjacent inactive landfill (Site 1). The SI for both sites consisted of subsurface explorations at 11 locations and the installation of four monitoring wells screened in the till, and multi-level piezometers with discrete screening intervals in both the fractured shale and till. In addition, one surface water sample, three soil/sediment samples, and eight soil samples (ranging from 4 to 31 feet bgs) were collected. SI sampling locations are shown in Figure 2-5. Analytical results relevant to Site 2 are listed in Table 2-5.

Sediment sample JSD-100, collected from a man-made depression located approximately 450 feet from Site 2 in the "Pond Area," contained DDT, DDE, and DDD at 3100 microgram per kilogram ($\mu\text{g}/\text{kg}$), 230 $\mu\text{g}/\text{kg}$, and 170 $\mu\text{g}/\text{kg}$, respectively. E.C. Jordan used these data along with the previous Dames and Moore data to evaluate risk and fate and transport for the site contaminants.

E.C. Jordan conducted an additional sampling program in 1989 to further examine the contaminant levels downgradient of Site 2, consisting of 12 surface soil samples in the landfill area and groundwater samples from four existing monitoring wells. Supplemental sample locations are shown in Figure 2-6 and the analytical results are presented in Table 2-6. Pesticides including DDE, DDD, and DDT were detected in numerous soil samples (e.g. SS-3, SS-6, SS-8, SS-11, and SS-12) at concentrations up to 490 $\mu\text{g}/\text{kg}$ (DDE at SS-11). High concentrations of DDT and its derivatives were also reported in monitoring well SW-02 (760 micrograms per liter [$\mu\text{g}/\text{L}$] DDT), suggesting impacts to groundwater. An oily sheen was observed in the water sample from SW-02.

TABLE 2-4
SITE 2 - ANALYTICAL RESULTS FOR TEST PITS
REMOVAL ACTION EXCAVATION
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

[illegible]

TABLE 2-4, (cont.)
 SITE 2 - ANALYTICAL RESULTS FOR TEST PITS
 REMOVAL ACTION EXCAVATION
 STEWART AIR NATIONAL GUARD BASE
 NEWBURGH, NEW YORK

PARAMETER	UNITS	SAMPLE LOCATION/DEPTH						
		ROW 1 4 FEET	ROW 1 6 FEET	ROW 2 2 FEET	ROW 2 4 FEET	ROW 2 6 FEET	ROW 3 2 FEET	ROW 3 4 FEET
Volatile Organics								
Benzene	µg/kg	<50	<50	<6.0	<50	<50	<50	<50
Toluene	µg/kg	<50	<50	<6.0	<50	<50	<50	73
Xylenes	µg/kg	<125	<125	<6.0	350	<125	940	2100
Pesticides								
4,4'-DDT	mg/kg	13	2.6	8.9	80	4.6	30	110
4,4'-DDE	mg/kg	0.28	0.06	0.11	1.6	0.11	0.57	1.8
4,4'-DDD	mg/kg	6.5	1.6	2.1	33	2	6.4	20
Heptachlor	mg/kg	<0.16	<0.08	<0.08	<0.16	<0.08	<0.16	<0.16
Parathion	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2,4-D	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2,4,5-T	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

TABLE 2-4, (cont.)
 SITE 2 - ANALYTICAL RESULTS FOR TEST PITS
 REMOVAL ACTION EXCAVATION
 STEWART AIR NATIONAL GUARD BASE
 NEWBURGH, NEW YORK

PARAMETER	UNITS	SAMPLE LOCATION/DEPTH							
		ROW 3 6 FEET	ROW 4 2 FEET	ROW 4 4 FEET	ROW 4 6 FEET	ROW 5 2 FEET	ROW 5 4 FEET	ROW 5 6 FEET	
Volatile Organics									
Benzene	µg/kg	<50	<50	<50	<50	<50	<50	<50	
Toluene	µg/kg	<50	<50	<50	<50	<50	<50	<50	
Xylenes	µg/kg	<125	<125	<125	<125	<125	<125	<125	
Pesticides									
4,4'-DDT	mg/kg	21	5	4	4.1	<0.016	<0.016	0.64	
4,4'-DDE	mg/kg	0.83	0.12	0.12	0.12	0.27	0.05	15	
4,4'-DDD	mg/kg	6.3	1.6	1.8	2.2	0.72	0.09	15	
Heptachlor	mg/kg	<0.16	<0.08	<0.08	<0.08	<0.008	<0.008	<0.160	
Parathion	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.1	
2,4-D	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2,4,5-T	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	

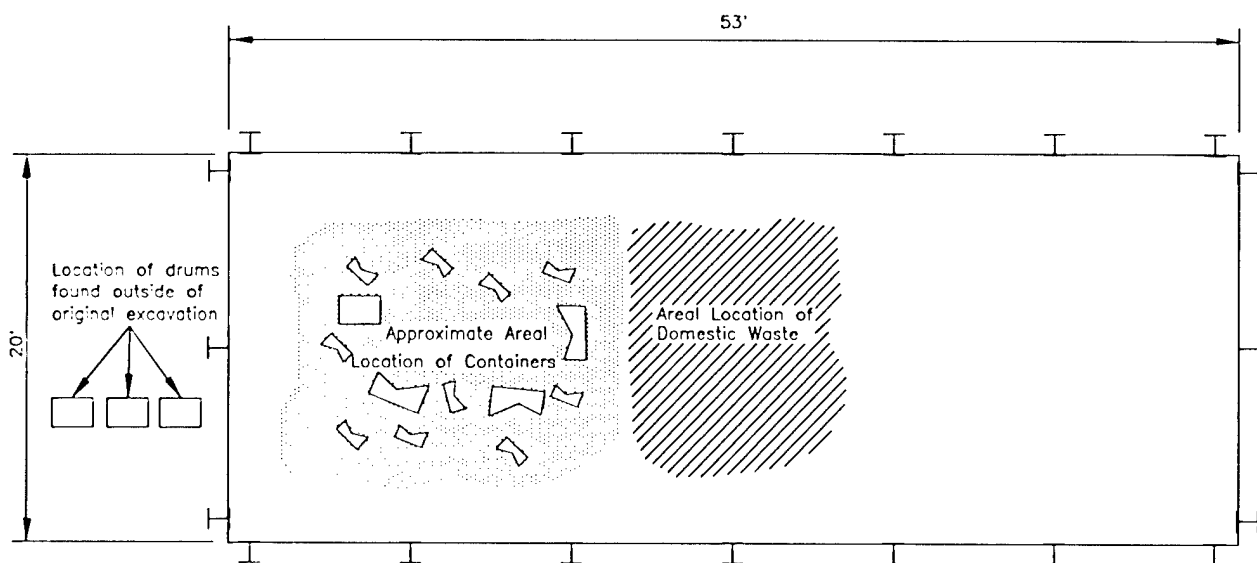
ABBREVIATIONS

µg/kg = micrograms per kilogram

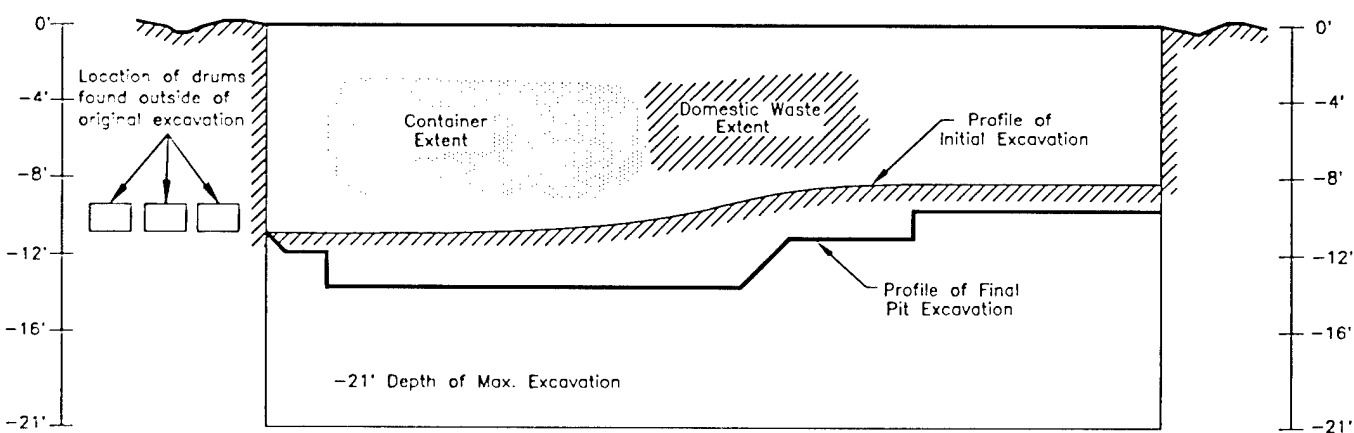
mg/kg = milligrams per kilogram

< = less than

Reference: Dynamac, 1988.



Plan View of Site 2, PPBA



Elevation View of Site 2, PPBA

SCALE



Reference: E.C. Jordan, 1988

STEWART AIR NATIONAL GUARD BASE
REMOVAL ACTION EXCAVATION SUMMARY

NEWBURGH, NEW YORK



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FIGURE: 2-4

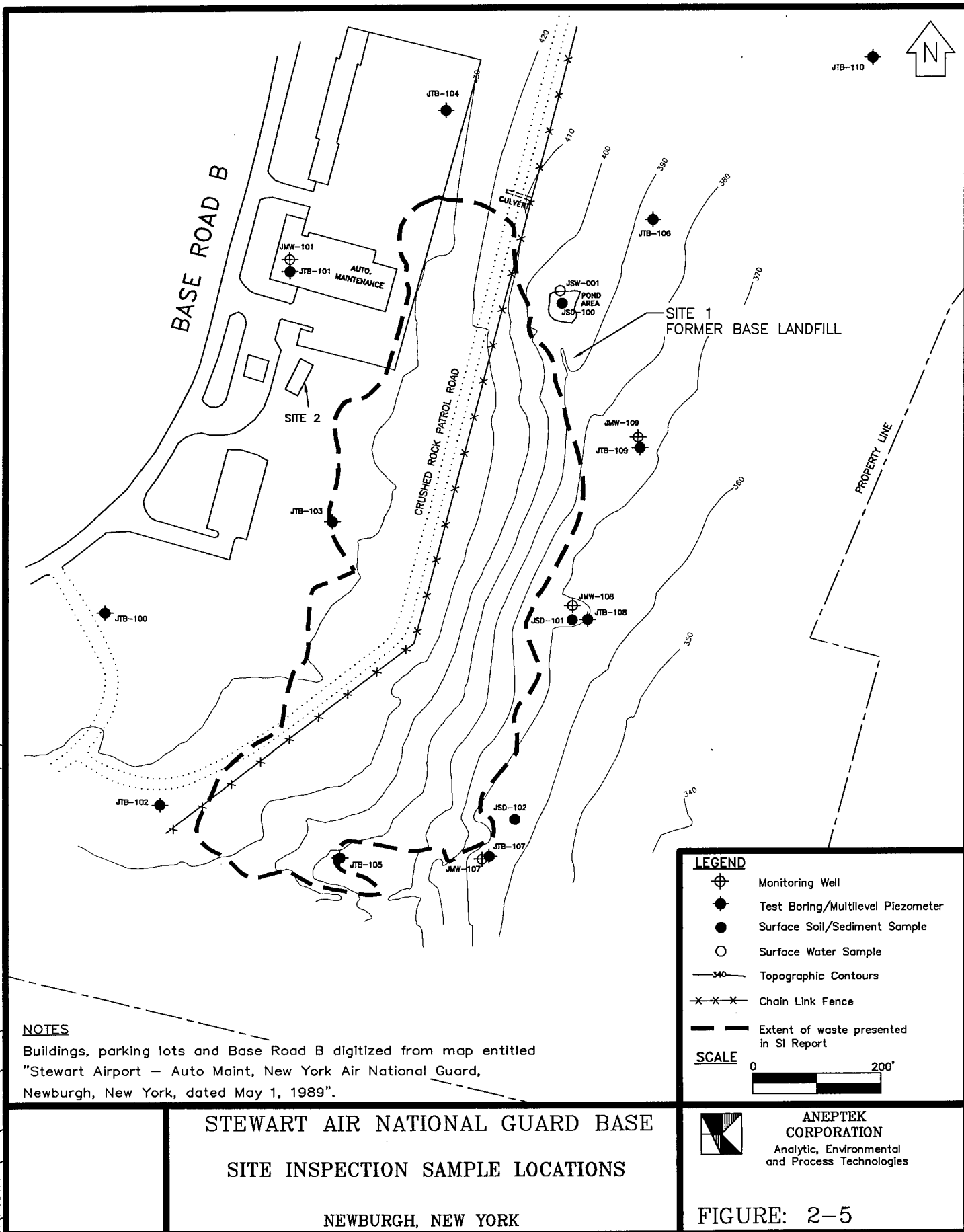


TABLE 2-5
PESTICIDE ANALYTICAL RESULTS FROM SITE INSPECTION
RELEVANT TO SITE 2
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE ID	UNITS	PARAMETER		
		4,4'-DDT	4,4'-DDE	4,4'-DDD
Sediment				
JSD-100	µg/kg	3100 ¹	230 ¹	170 ¹
JSD-101	µg/kg	ND	ND	ND
JSD-102	µg/kg	ND	ND	ND
Subsurface Soil				
JMW-101	µg/kg	ND	ND	ND
JMW-107	µg/kg	ND	ND	ND
JMW-108	µg/kg	ND	ND	ND
JMW-109	µg/kg	ND	ND	ND
JTB-102	µg/kg	ND	ND	ND
JTB-103	µg/kg	ND	ND	ND
JTB-105	µg/kg	ND	ND	ND
JTB-106	µg/kg	ND	ND	ND
Surface Water				
JSW-001	µg/L	0.57	ND	ND
Groundwater				
JMW-101	µg/L	ND	ND	ND
JMW-107	µg/L	ND	ND	ND
JMW-108	µg/L	ND	ND	ND
JMW-109	µg/L	ND	ND	ND

ABBREVIATIONS

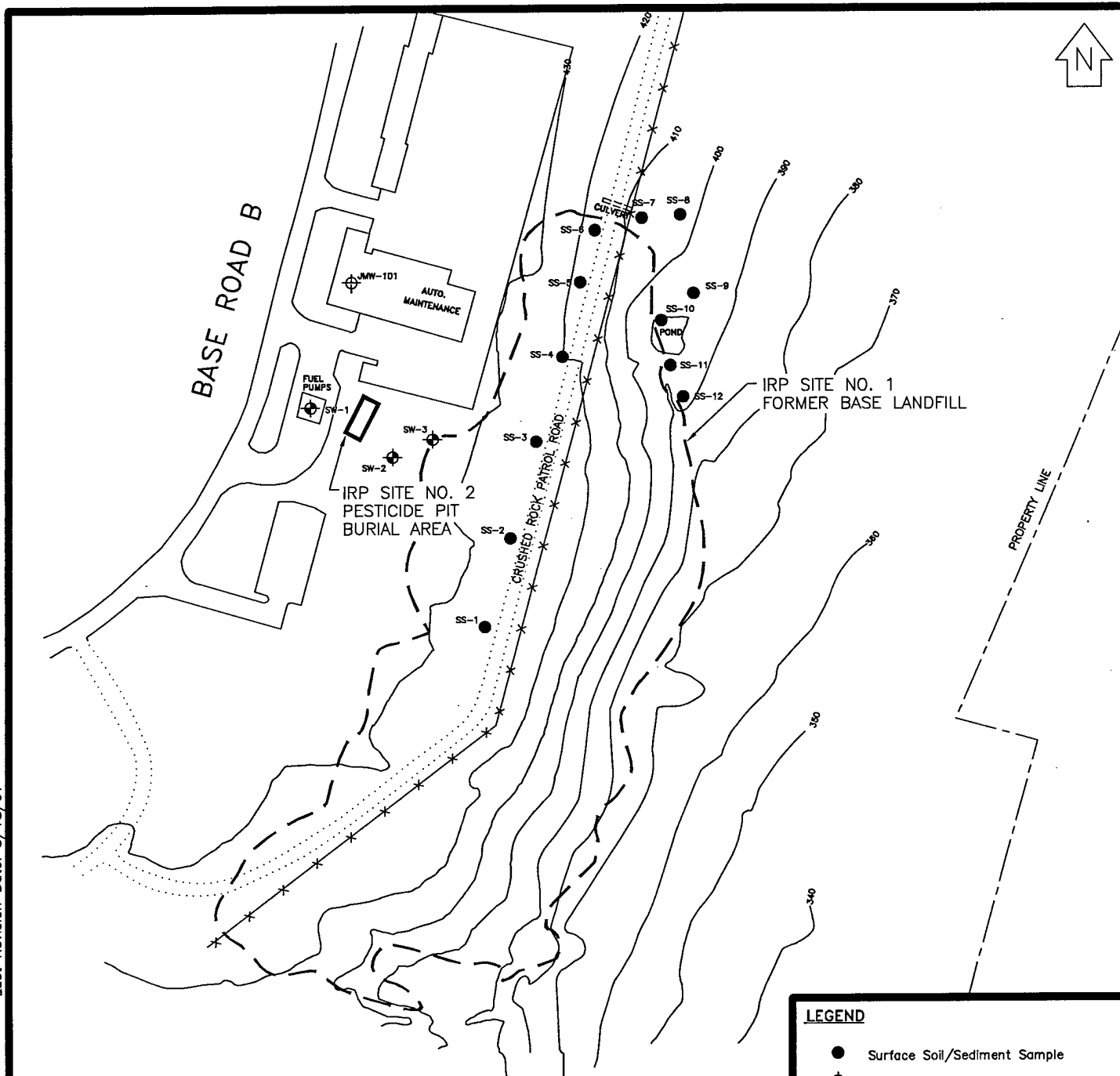
µg/kg = micrograms per kilogram
µ/L = micrograms per liter

NOTES

1. Value is the highest reported of the replicates analyzed

ND = Not Detected

Reference: E.C. Jordan, 1989.



Reference: E.C. Jordan, 1988

STEWART AIR NATIONAL GUARD BASE
SUPPLEMENTAL SITE INSPECTION
SAMPLE LOCATIONS
 NEWBURGH, NEW YORK

LEGEND

- Surface Soil/Sediment Sample
- ⊕ Existing Monitorin Well
- × × × Chain Link Fence
- 340 — Topographic Contour Lines

SCALE



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FIGURE: 2-6

TABLE 2-6
SITE 2 - ANALYTICAL RESULTS
FROM SUPPLEMENTAL SITE INSPECTION
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE ID	UNITS	PARAMETER					DIELDRIN
		4,4'-DDT	4,4'-DDE	4,4'-DDD	HEPTACHLOR	gamma-CHLORDANE	
Surface Soil/ Sediment							
SS-1	µg/kg	ND	ND	ND	ND	ND	ND
SS-2	µg/kg	ND	ND	ND	ND	ND	ND
SS-3	µg/kg	ND	240	ND	29	75	ND
SS-4	µg/kg	ND	ND	ND	ND	ND	ND
SS-5	µg/kg	ND	ND	ND	ND	ND	ND
SS-6	µg/kg	ND	94	ND	ND	ND	ND
SS-7	µg/kg	ND	ND	ND	ND	ND	ND
SS-8	µg/kg	ND	50	ND	ND	ND	ND
SS-8 (dup)	µg/kg	42	ND	ND	ND	ND	ND
SS-9	µg/kg	ND	ND	ND	ND	ND	ND
SS-10	µg/kg	ND	ND	ND	ND	ND	ND
SS-11	µg/kg	150	490	49	ND	ND	110
SS-12	µg/kg	ND	42	ND	ND	ND	ND
Groundwater							
SW-1	µg/L	ND	ND	ND	ND	ND	ND
SW-2	µg/L	760	66	230	ND	ND	ND
SW-3	µg/L	ND	ND	0.2	ND	ND	ND
JMW-101	µg/L	ND	ND	ND	ND	ND	ND

ABBREVIATIONS

ND = Not Detected

µg/kg = micrograms per kilogram

µg/l = micrograms per liter

Reference: E.C. Jordan, 1989

2.3.5.1 Fate and Transport Analysis (E.C. Jordan, 1989)

Several pesticides and herbicides were evaluated during the fate and transport analysis. DDT and its breakdown products (DDD and DDE) tended to be the most persistent, because these compounds had the longest half-lives and tended to more tightly adsorb to the organic fraction of the soil. The fate and transport analysis indicated that these constituents would be very slowly transported to surface water by one of two mechanisms: (1) subsurface transport of dissolved contamination via contaminated groundwater to a location where it would discharge to surface water; and (2) surface transport of pesticides adsorbed to the soil carried in runoff to a surface water body. Once in a larger surface water body, the pesticides could partition between the soil and water phases.

The other contaminants evaluated, methyl-parathion, 2,4-D, and 2,4,5-T, all had much lower organic-carbon partition coefficient (K_{oc}) values, and therefore would move much more readily with the groundwater. These chemicals also tended to degrade much more rapidly than DDT, either by biodegradation or hydrolysis, indicating that their persistence in the environment would be limited.

As part of the fate and transport analysis, several groundwater models were run (E.C. Jordan, 1989). The modeling results indicated that transport of DDT, DDE, and DDD via groundwater would be insignificant. The model showed that measurable concentrations of DDT, DDE, and DDD would not be found in monitoring wells 1,000 and 1,500 feet downgradient of Site 2. The models also indicated that measurable concentrations of DDT, DDE, and DDD would not be transported to Murphy's Gulch via groundwater.

The conclusion of this analysis was that the pesticides detected in the ponded area north of the landfill must have been transported via erosion of contaminated surface soils, and that this transport mechanism would be the major concern at Site 2.

SECTION 3.0

3.0 ENVIRONMENTAL SETTING

This section presents a description of the location and environmental setting in the vicinity of Site 2. Information provided in this section has been obtained through a review of available literature, records pertaining to Site 2 (including the SI report (E.C. Jordan, 1989)), visual observations made by Aneptek during a pre-investigation site visit, and interviews with Base personnel familiar with the history of Site 2.

3.1 Site Physiography and Topography

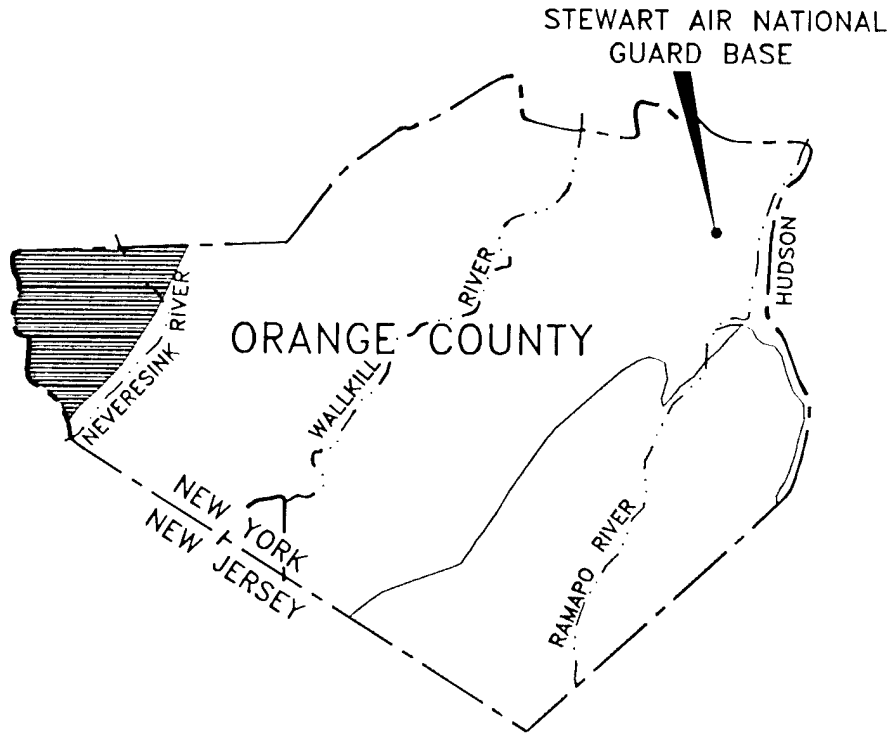
The site is located within the central portion of Orange County, within the Hudson-Champlain lowland of the Valley and Ridge Province (Frimpter, 1972) (Figure 3-1). The topography in the immediate vicinity of the base is gently to moderately rolling, consisting of drumlin hills shaped by successive advances of Pleistocene continental glaciations (Cadwell, 1989) (see also Section 3.2.2). The site itself is part of the eastern upper side slope of a drumlin that was modified during construction of the Base (U.S. Army Corps of Engineers [USACOE], 1943).

Site 2 is located at the same general surface elevation of the Base, within a generally flat, open field where elevation gradually increases (east to west) from approximately 430 feet to 436 feet above mean sea level (msl). Steep slopes with grades in excess of 35 percent (35 foot elevation drop over approximately 100 feet) are found within 400 feet of Site 2, within the former landfill (Site 1). Grades decrease further east, towards Murphy's Gulch.






The extent of topography alteration in the vicinity of Site 2 is shown on Figure 3-2, which was derived from as-built grading plan record drawings obtained from the Stewart IAP Engineering Office (USACOE, 1943). Figure 3-2 shows that prior to the expansion of the runways, a drumlin with a peak greater than 525 feet msl existed on the eastern side of the Base. The east side of the Base was regraded to an elevation of approximately 440 feet msl during the expansion. Prior to regrading, Site 2 was situated below the east face of the drumlin crest. The ground surface in the vicinity of Site 2 appears to have been lowered approximately 50 to 60 feet to achieve its current elevation.

3.2 Regional/Local Geology

The geology of the Newburgh, NY area is depicted in Figure 3-3. The general stratigraphic sequence below Site 2, shown in Figure 3-4, is based on literature information and data obtained during previous investigations. Logs for borings advanced in the vicinity of Site 2 during previous investigations are provided in Appendix A. The soil and rock coring conducted during this investigation confirm this general stratigraphic sequence.



LEGEND

-  Appalachian Plateau Province
-  Valley and Ridge Province
-  New England Province
-  County Boundary
-  Physiographic Province Boundary

SCALE



STEWART AIR NATIONAL GUARD BASE
 PHYSIOGRAPHIC PROVINCES
 OF ORANGE COUNTY
 NEWBURGH, NEW YORK

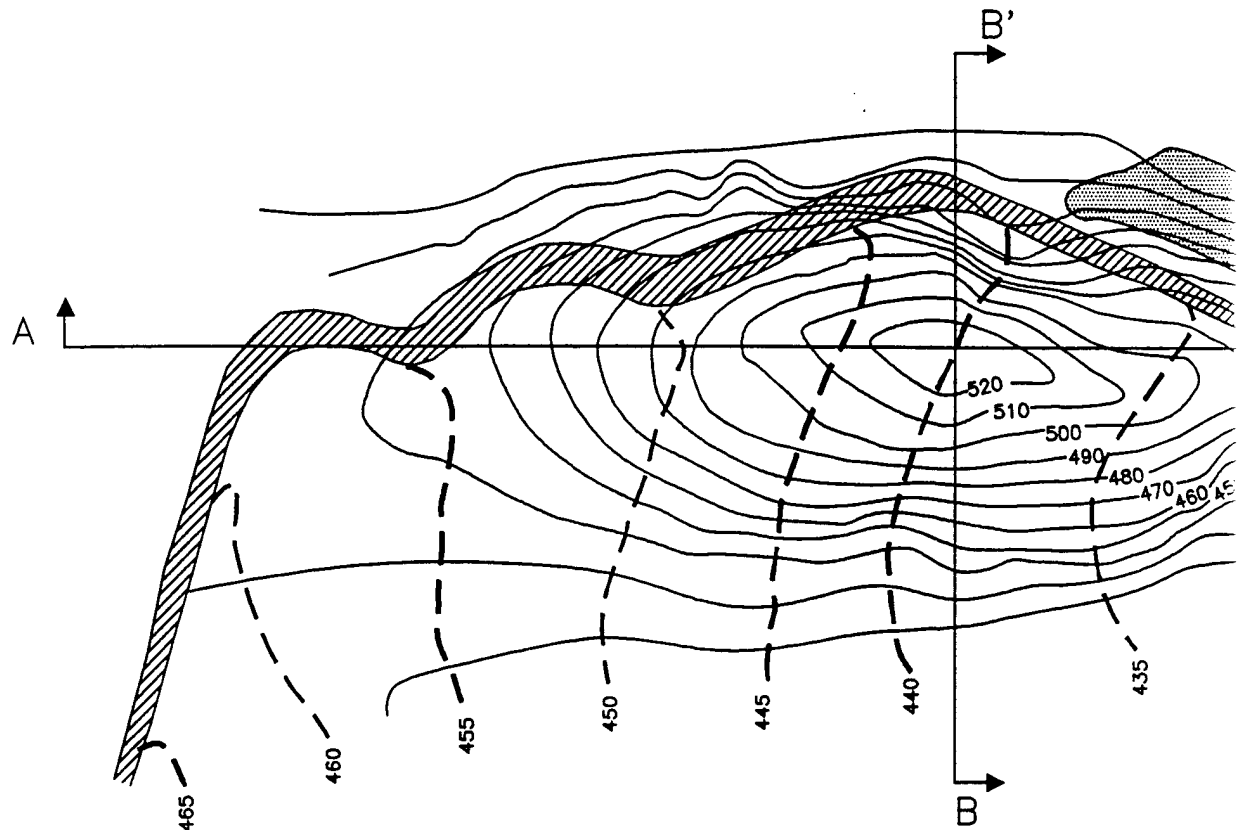


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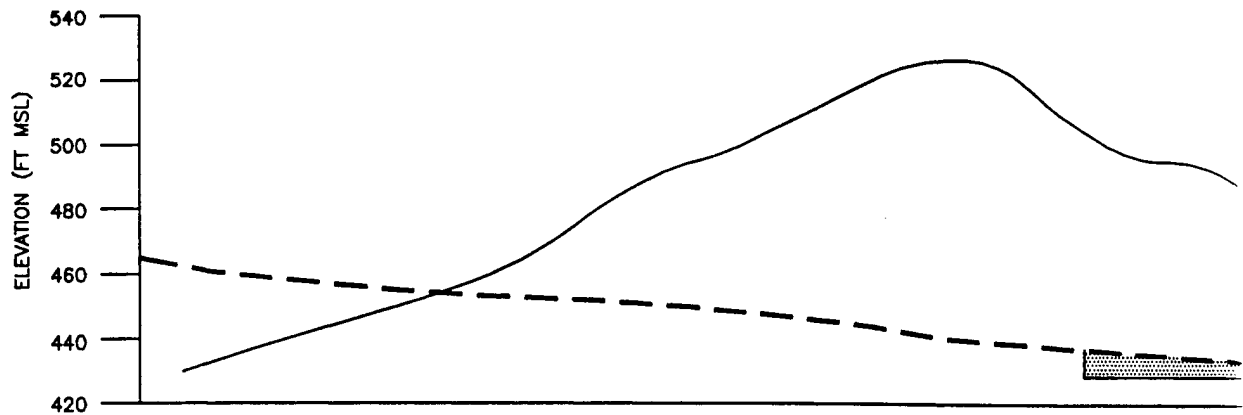
FIGURE: 3-1

Last Revision Date: 3/20/97

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PLAN VIEW

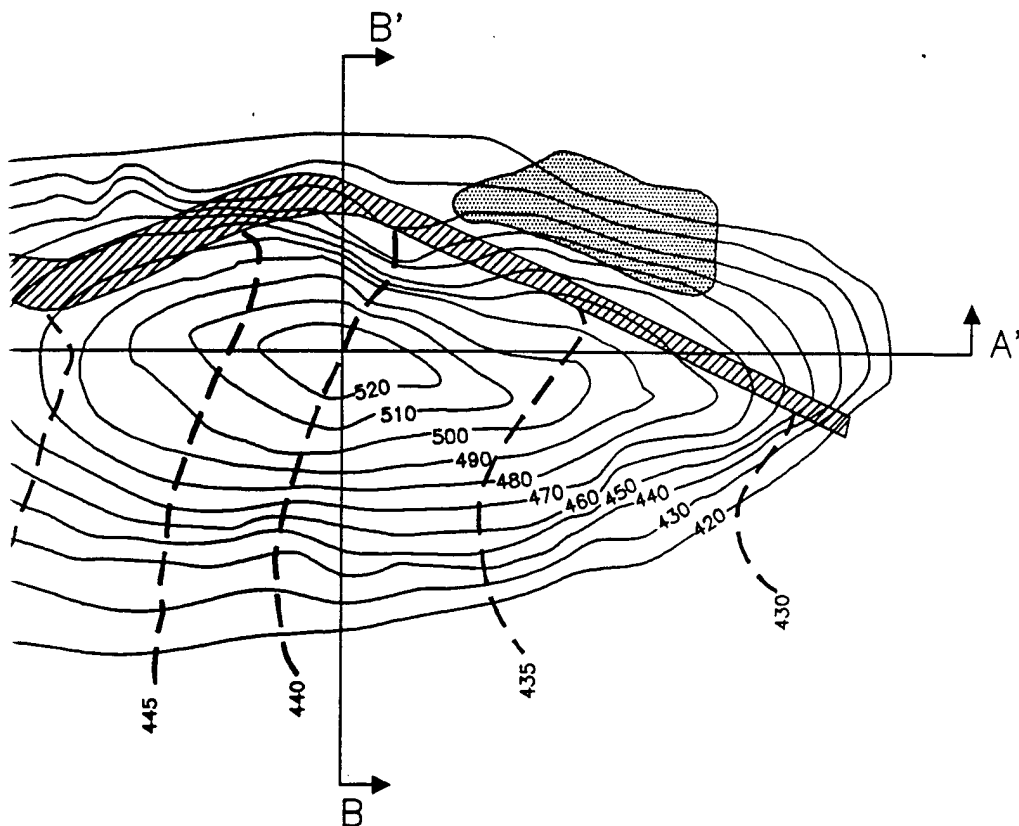


CROSS SECTION A - A'

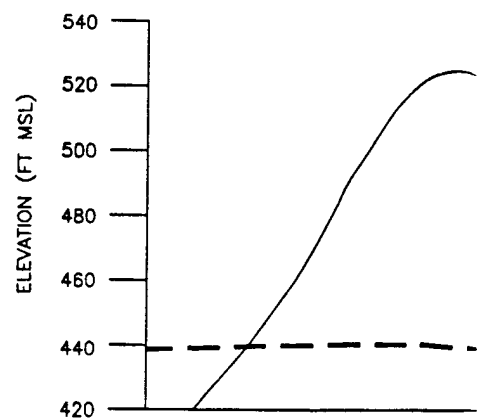
STEWART AIR NATIONAL AIR FORCE

PLAN AND CROSS SECTION VIEWS OF CUT AND FILL

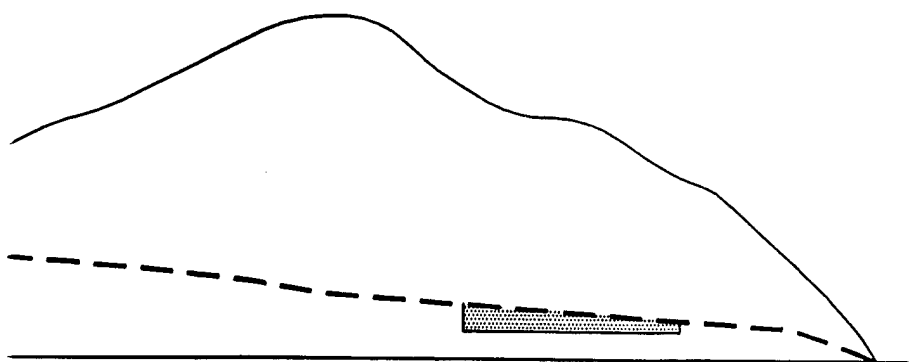
NEWBURGH, NEW YORK



PLAN VIEW



CROSS SECTION

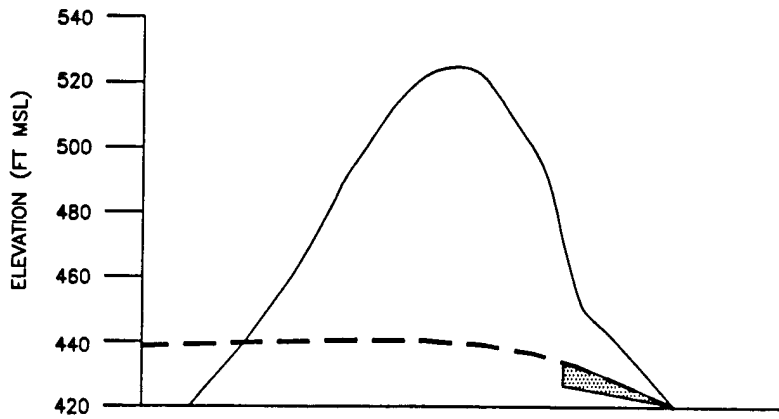


CROSS SECTION A - A'

STEWART AIR NATIONAL GUARD BASE





CROSS SECTION VIEWS OF CUT AND FILL OPERATIONS CONDUCTED IN THE 1940's

NEWBURGH, NEW YORK

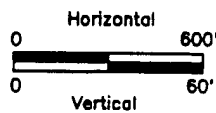


CROSS SECTION B - B'

LEGEND

-  Former Ground Surface Elevation (ft msl)
-  Current Ground Surface Elevation (ft msl)
-  Approximate Location of Site 1
- ft msl Elevation in feet above mean sea level
-  Ditch

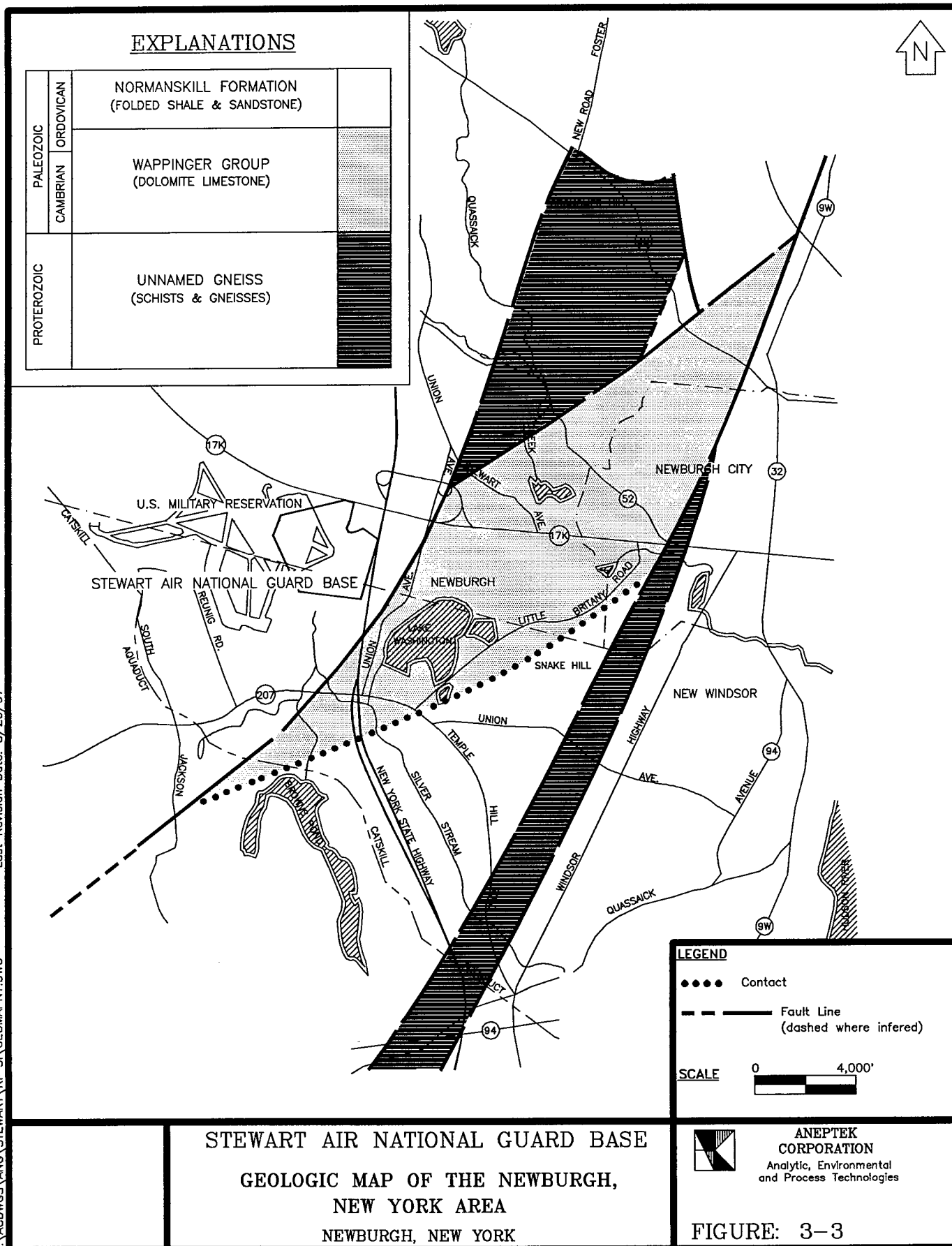
SCALE



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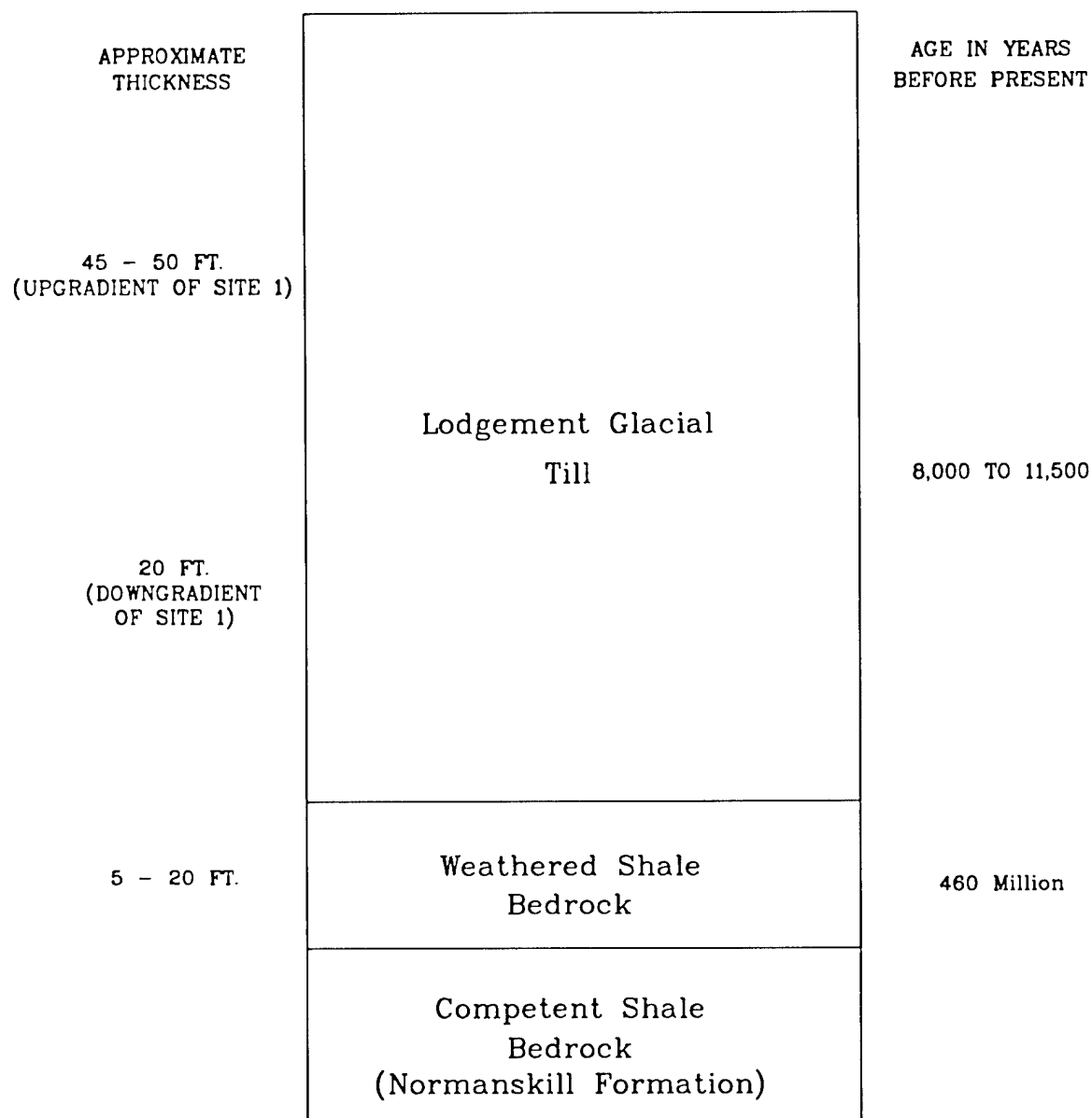
DUCTED IN THE 1940's

FIGURE: 3-2



Lost Revision Date: 3/18/97

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STEWART AIR NATIONAL GUARD BASE

GENERAL STRATIGRAPHIC COLUMN

NEWBURGH, NEW YORK



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and Process Technologies

FIGURE: 3-4

3.2.1 Bedrock Geology

Regional lithology of a large portion of the Hudson-Champlain Valley, which includes the Base, consists of alternating layers of soft shales, argillite, and sandstones (Fisher et. al., 1970). The shales comprise the youngest geologic unit in the area, are referred to as the Normanskill Formation.

According to references cited in the SI (ABB, 1992), regional bedrock structure consists of isoclinal folding throughout the formation, with the long axis trending north-northeast. Overturned folds are observed to the west. Bedding dips to the east, although a platey cleavage oriented 30 degrees from bedding is also observed. In addition, Figure 3-3 shows an interpreted thrust fault east of the Base, striking northeast, which placed Cambrian dolomites and Precambrian metamorphic rocks (schists and gneisses) of the Hudson Highlands over the younger Ordovician sedimentary rocks.

Previous investigations at Site 2 (Dames and Moore, 1986 and ABB, 1992) indicate that the bedrock is predominantly composed of the middle Ordovician age (450-425 million years before present), thinly bedded and fractured Martinsburg shale member of the Normanskill Formation (Fisher, et. al., 1970). SI rock core logs describe these rocks as thinly laminated, gray to blackish shale with calcite lenses and veins with occasional layers of sandstone (ABB, 1992). SI data indicate that in the vicinity of Site 2, the top of bedrock occurs at depths between 45 and 50 feet bgs, while downslope from Site 2, the contact occurs at depths between 15 and 25 feet bgs (Dames and Moore, 1986). Overlying the competent, unweathered shale is a zone herein referred to as weathered fractured shale, ranging from 2.5 to 10 feet thick (Dames and Moore, 1986). The upper portion of this zone is characterized by rock that has decayed to the consistency of soil, grading downward to rock that is highly fractured, but exhibiting less chemical and physical weathering.

Based on SI rock cores, local bedrock structure is described as highly fractured and/or weathered to soil in the upper 10 feet below the overburden/bedrock interface, with competency (lack of fracturing and weathering) increasing with depth. Bedding observed in the SI cores is approximately 45 degrees from vertical, although one core showed lower angle bedding (70 degrees off the vertical). The SI stated that most fractures and core breaks are parallel and subparallel to observed bedding surfaces. Subvertical joint planes were observed in some cores. Evidence of faulting is observed in cores from the southerly and eastern portions of the SI study area (ABB, 1992), in the form of highly fractured cores and/or slickensides.

3.2.2 Surficial Geology

According to Cadwell (1989), in the vicinity of the Base the overburden is primarily composed of lodgement (basal) till. Lodgement till consists of relatively low permeability, very dense, non-stratified, very poorly sorted clay to boulder sized material that was deposited at the base of advancing Pleistocene temperate or wet-based glaciers. It is derived from scouring, crushing and redeposition of pre-existing topographically exposed soil and rock under tremendous pressure.

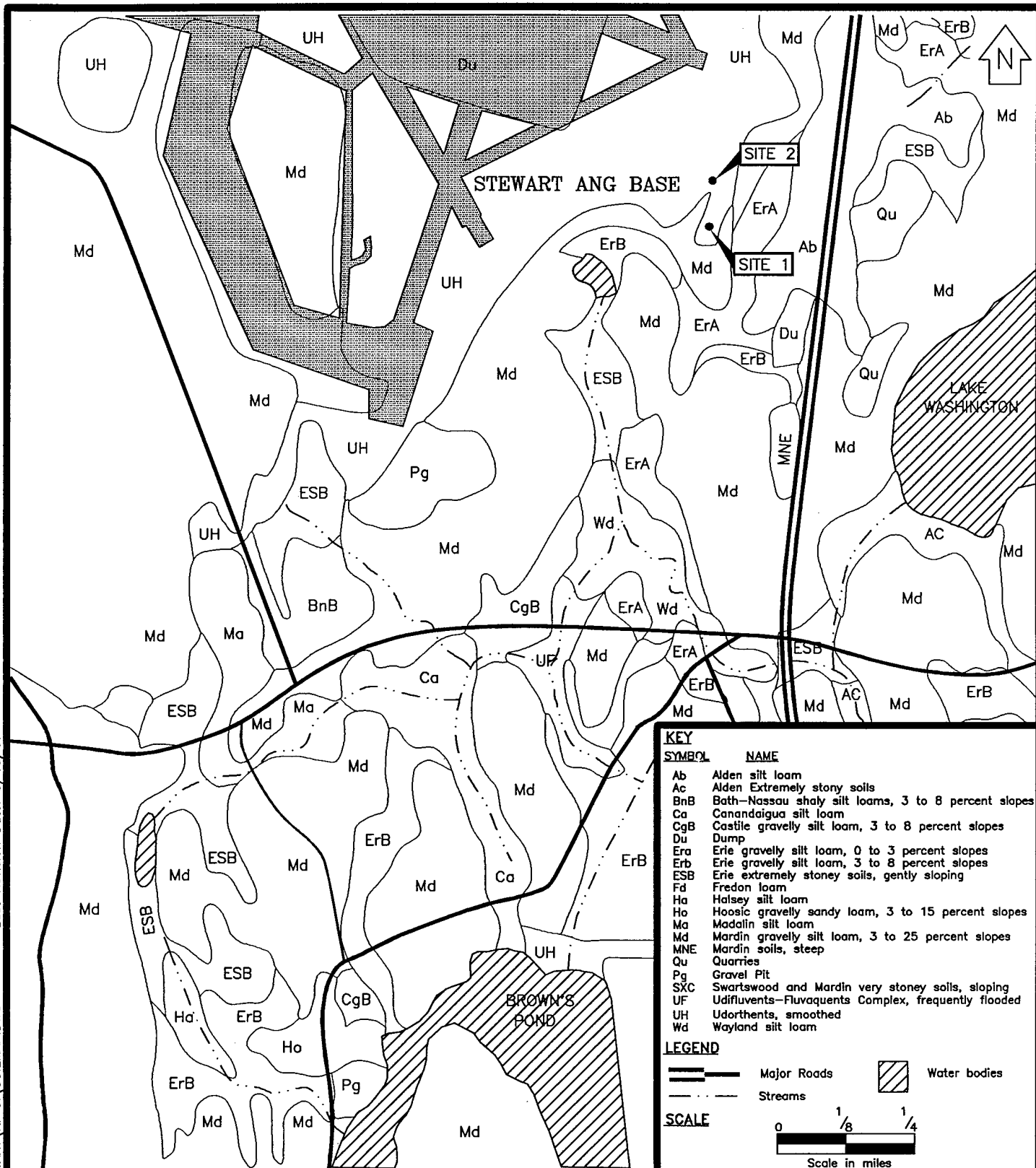
In this area, the till is often clay rich due to its origin (provenance) from shale bedrock parent material.

The primary landforms in this region are ground moraines and drumlins derived from advancing glaciers. Ground moraine consists of rolling, hilly terrain composed of lodgement till deposited on bedrock. Thicker deposits of till are found in the valleys than in the higher elevations because the thicker ice accumulation in the valleys remained active longer than the thinner ice at the higher elevations (Cadwell, 1989). The till thickness averages 20 feet but is dependent upon the bedrock irregularities (Frimpter, 1972). Drumlins are ice-molded, tear-drop or elliptically shaped hills that are aligned parallel to glacial flow with the blunt end oriented opposite the direction of glacier movement. They are thought to form as the ice sheet moves over resistant outcrops of bedrock, causing lodgement till to be "plastered" onto the resistant bedrock outcrop under very high pressure. Numerous drumlins are found in this region. The thickness of the till in the drumlins can vary from 75 to 200 feet (Frimpter, 1972).

The overburden at Site 2 consists primarily of grey to dark grey, very dense, poorly sorted glacial till, overlain by brown weathered till also referred to in the SI as "ablation till" (ABB, 1992). The "ablation till" term is not considered correct because ablation till is material contained within a glacier that is deposited as ice melts. It is less dense than lodgement till and is often of different composition than the underlying lodgement till. The less dense till at this site is interpreted to be a product of the weathering of the underlying lodgement till and any site-specific reference to this stratum will be referred to herein as weathered till. Near the surface at Site 2, a layer of disturbed till resulting from on-site activities including road construction and the burial of the pesticide drums is present. The upper till unit tends to contain more sands in the vicinity of Site 2 (Dames and Moore, 1986). The SI also identified a thin, discontinuous layer of "slope wash" or lacustrine material at lower elevations that was not separately mapped. SI grain-size analyses of 12 soil samples generally were described as "well-graded material with a fine fraction" (smaller than 200 sieve) of 27 to 55 percent and "a slight bimodal grain-size distribution."

3.3 Soils

Soils at the site are mapped as "Udorthents, Smoothed" (Soil Conservation Service [SCS], 1975). This soil unit is assigned to any area that has been subject to activities such as regrading. Surrounding undisturbed soil units are mapped primarily as Mardin-Erie gravelly silt loams, which are described as upland glacial till deposits (Figure 3-5). These soils are categorized as gently sloping to sloping, deep, moderately well drained to somewhat poorly drained, medium textured soils (ABB, 1992). Records indicate that the roads and runways on the Base were constructed using fill from local sources, which would be primarily the same class of soil (ABB, 1992).



SYMBOL	NAME
Ab	Alden silt loam
Ac	Alden Extremely stony soils
BnB	Bath-Nassau shaly silt loams, 3 to 8 percent slopes
Ca	Canandaigua silt loam
CgB	Castile gravelly silt loam, 3 to 8 percent slopes
Du	Dump
ErA	Erie gravelly silt loam, 0 to 3 percent slopes
ErB	Erie gravelly silt loam, 3 to 8 percent slopes
ESB	Erie extremely stony soils, gently sloping
Fd	Fredon loam
Ha	Halsey silt loam
Ho	Hoosic gravelly sandy loam, 3 to 15 percent slopes
Ma	Madalin silt loam
Md	Mardin gravelly silt loam, 3 to 25 percent slopes
MNE	Mardin soils, steep
Qu	Quarries
Pg	Gravel Pit
SXC	Swartswood and Mardin very stoney soils, sloping
UF	Udfluvents-Fluvaquents Complex, frequently flooded
UH	Udorthents, smoothed
Wd	Wayland silt loam

LEGEND

Major Roads
 Streams
 Water bodies

SCALE

0 1/8 1/4

Scale in miles

STEWART AIR NATIONAL GUARD BASE

SOIL MAP

NEWBURGH, NEW YORK



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FIGURE: 3-5

3.4 Surface Hydrology

The Base has few surface water features. Surface water runoff at the Base is controlled by a storm water drain system (Figure 3-6). Storm water over the majority of the Base flows via this storm water system into Recreation Pond south of the Base. In the vicinity of Site 2, storm water runoff is not captured by the drainage system, but rather flows as overland runoff to a drainage swale on the western side of the crushed stone Patrol Road and then north to a culvert running under the road. Discharge from the culvert continues to flow eastward eventually entering Murphy's Gulch, located approximately 1,000 feet east of Site 2. This area was developed, beginning approximately 1987. Prior to this development the crushed rock Patrol Road did not exist, and storm water runoff was allowed to flow over the side slope. This runoff flowed to the pond area north of Site 1, with the overflow eventually reaching Murphy's Gulch. Murphy's Gulch also receives runoff from the New Windsor Landfill.

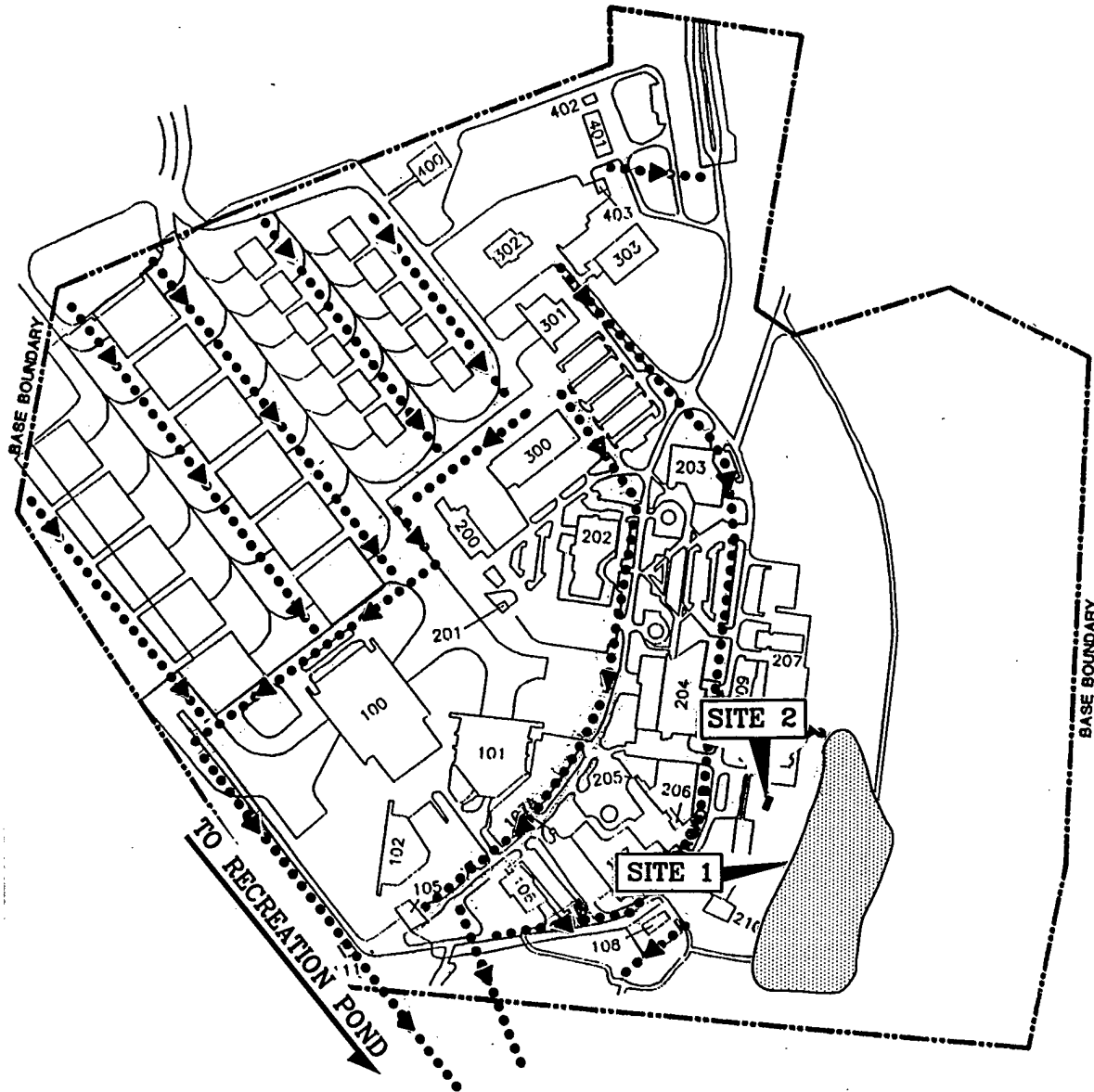
After entering Murphy's Gulch surface water flows north and east under Route 87. This water then flows through Murphy's Gate, a diversion structure which formerly diverted water into Lake Washington. This gate has been closed due to the potential for the introduction of contamination into Lake Washington, the source of which has not yet been determined. This surface water eventually flows into Brookside Pond and Quassaic Creek. Quassaic Creek discharges into the Hudson River. Drainage patterns for the area downgradient of Site 2 are illustrated in Figure 3-7.

3.5 Regional/Local Hydrogeology


Regional groundwater flow in the vicinity of Site 2 is southeast towards the Hudson River, based on the elevations of surface water bodies located near the Base. Groundwater movement occurs primarily in the weathered till, the underlying lodgement till to a lesser extent, and in the underlying bedrock. However, the Normanskill Formation and underlying bedrock tend to have low permeabilities, and are poor sources of groundwater (ABB, 1992). A well drilled to a depth of more than 1,000 feet in 1987 yielded less than 10 gallons per minute (gpm). Groundwater flow in the bedrock is primarily controlled by joints, fractures and bedding planes (Frimpter, 1972).

Groundwater was encountered at a depth of approximately 30 feet below grade (E.C. Jordan, 1989), in the vicinity of Site 2. The groundwater was believed to be perched on top of the bedrock. In addition, during the drilling of monitoring wells SW-01, SW-02 and SW-03 for the Site 2 hydrogeologic investigation, abundant groundwater was encountered under pressure in the weathered rock zone (Dames and Moore, 1986).

Based on potentiometric data obtained from the monitoring wells and multi-level piezometers installed as part of the SI, groundwater flow in the till and fractured shale was interpreted to be eastward, towards the toe of the former landfill. The horizontal hydraulic gradient in the area of Site 2 (i.e., between JTB-101B and JTB-108B) was calculated to be 0.07 foot per foot (ft/ft). SI groundwater contours for Site 2 area are illustrated in Figure 3-8. Monitoring well



LEGEND

- Base Boundary
- 303 Building/Building Number
-  Aircraft Parking Area
- Base Drainage Flow

SCALE



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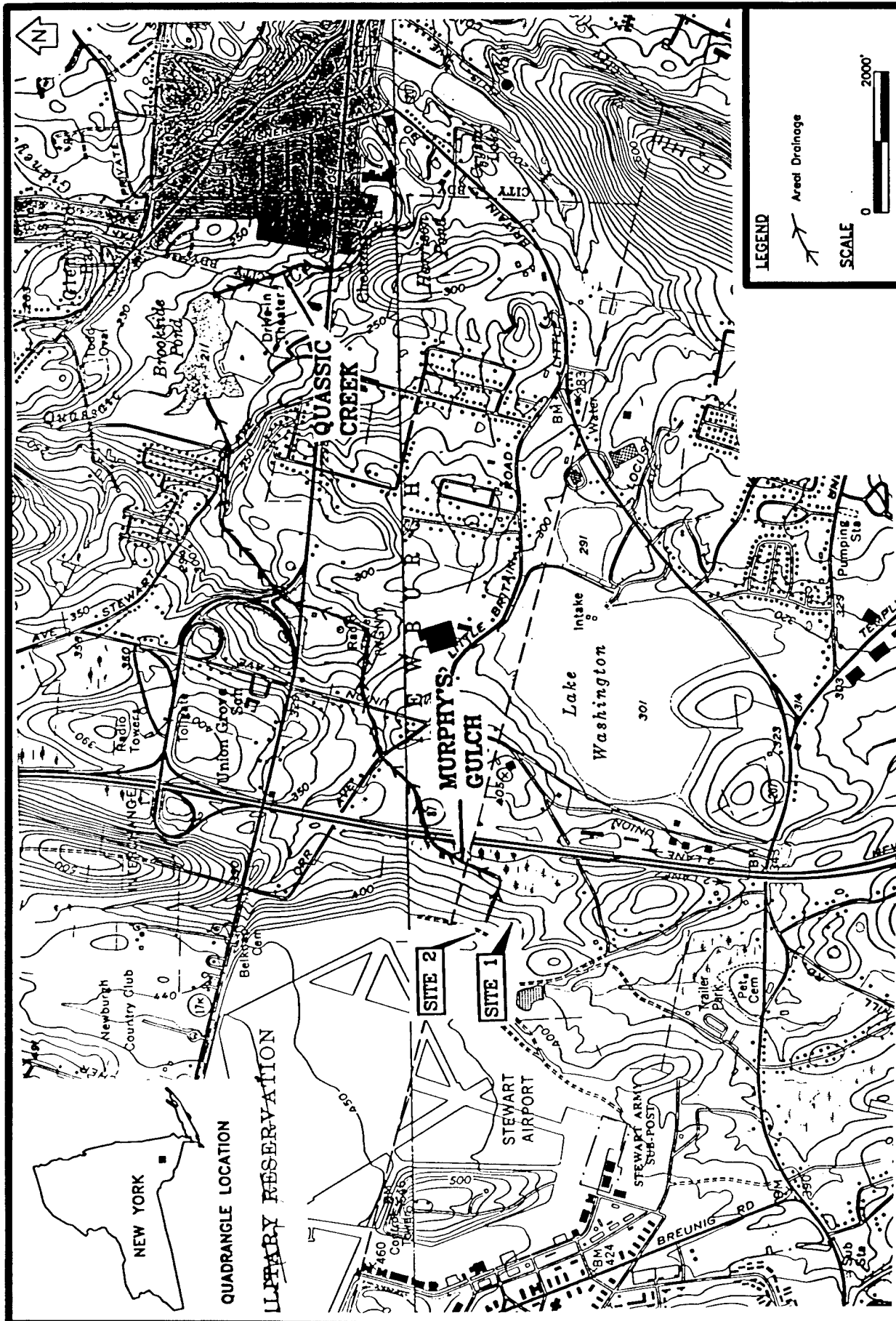
SOURCE: 105TH AIRLIFT GROUP, STEWART INTERNATIONAL AIRPORT, BASE MAP, 1993.

STEWART AIR NATIONAL GUARD BASE

BASE STORMWATER DRAINAGE MAP

NEWBURGH, NEW YORK

FIGURE: 3-6



STEWART AIR NATIONAL GUARD BASE

AREAL DRAINAGE MAP

NEWBURGH, NEW YORK

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FIGURE: 3-7

construction details for wells located in the vicinity of Site 2 are provided in Section 6. SI monitoring well construction diagrams are provided in Appendix A, Basewide Site Investigation Data.

Vertical gradients were downward at all locations except at multi-level piezometers JTB-108 and JTB-110. Downward hydraulic gradients in the bedrock were calculated to range from 0.005 to 0.239 ft/ft. Downward gradients in the till were calculated to range from 0.515 to 0.878 ft/ft. Upward gradients were found to range from 0.01 to 0.03 ft/ft. The fact that downward gradients were encountered on the up-slope side of the landfill and upward gradients were encountered closer to Murphy's Gulch suggests that groundwater from the vicinity of Site 2 is likely discharging into Murphy's Gulch.

During the Site 2 hydrogeologic investigation, estimates of the hydraulic conductivity of the weathered fractured shale bedrock layer were made by performing in-situ variable head recovery slug tests on monitoring wells SW-01, SW-02 and SW-03. The average estimate for the three wells using the Hvorslev lag-time method is 5.6×10^{-5} centimeters per second (cm/sec) (Dames and Moore, 1986). Rising-head slug tests were also performed on the four monitoring wells installed as part of the SI. Based on this testing the average hydraulic conductivity of the lodgement till was found to be 4.19×10^{-5} cm/sec. One test performed within the weathered till yielded a hydraulic conductivity of 4.20×10^{-5} cm/sec.

3.6 Groundwater Usage

Groundwater usage in the vicinity of the Base appears to be limited to areas in which town water is not being supplied, where it was assumed that groundwater is used as the potable water supply. These areas include:

- Route 17K, west of the Thoroughway to East Coldenham.
- Orr Avenue, west of Union Avenue.
- Liner Avenue, west of Union Avenue and east of the Thruway.
- Silver Stream and Liner Roads, from Route 207 to the Thruway.
- All residences and businesses south of Route 207 in New Windsor.

Aneptek interviewed the Town of New Windsor Water Supply Engineer and the Town of Newburgh Tax Receiver and Building Inspector to determine where groundwater is used in the vicinity of the Base and to verify/update the information presented in the SI Report. The interviewed officials indicated that there still is no service along any part of Orr Avenue. Water mains have been installed along Route 17K, however, not every home or facility is hooked-up. This information indicates continued use of private wells for potable water. Also, not all homes and/or facilities located in areas in which town water is available are connected to the town water supply. Water distribution lines, lots served by known water wells, and areas supplied by individual water supply wells are shown on Figure 3-9. According to the Newburgh Building Inspector, municipalities do not keep records on individual wells, therefore it is impossible to determine in which formation individual wells are completed or exactly where they are located.

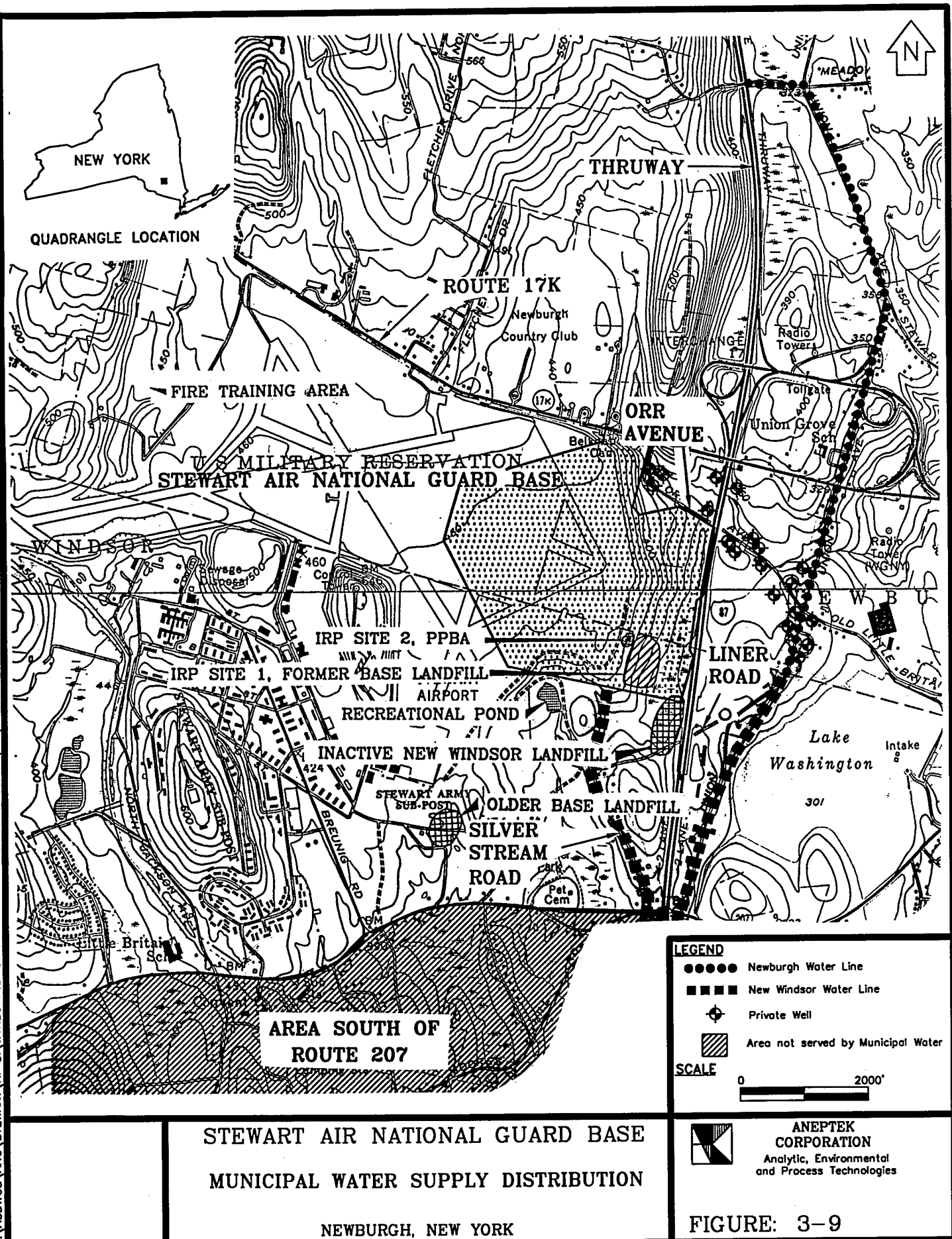


FIGURE: 3-9

3.7 Climate

Most of the climatic data for the Base were obtained from stations located at West Point, NY (SCS, 1981) and data collected at the Stewart Air Force Base (National Climatic Data Center [NCDC], 1995). The climate in the area is categorized as humid continental. The average daily temperature is 51.6°Fahrenheit (F), with cold winters and moderately warm summers. The lowest average daily minimum temperature, 19.2°F, occurs in January, and the highest average daily maximum temperature, 86.3°F occurs in July. The average wind speed is 8 knots, with a predominant westerly wind direction. The highest wind speed recorded at the Base was 84 knots, which occurred in June.

The average annual rainfall is 48.01 inches. The rainiest month is May, with an average rainfall of 3.94 inches. Typically, there are 8 to 11 days of measurable rainfall each month. The average annual net precipitation is 14 inches (precipitation minus (-) evapotranspiration). February and March are the snowiest months, with average snowfalls of 11.4 and 10.1 inches, respectively.

3.8 Ecology

No threatened or endangered habitats are located in the vicinity of Site 2 or within a two-mile radius. A wetland area is located to the east of Site 2, however, this area is not identified as a NYSDEC-regulated wetland. Six NYSDEC-regulated wetlands are located within a two-mile radius. Only one of these wetland areas is within the downstream pathway from the site. Area NB-29 is located approximately 7,000 feet downstream of Site 2. A detailed description of the ecological setting and potential impacts from Site 2 are presented in Section 8.2 of this report.

SECTION 4.0

4.0 IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This section presents an analysis of Federal and State Applicable or Relevant and Appropriate Requirements (ARARs) and additional criteria To-Be-Considered (TBC) for Site 2. This analysis considers the requirements of the "CERCLA Compliance with other Laws Manual" (Environmental Protection Agency [EPA], 1988a) as well as the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988b).

4.1 Definitions of ARARs and TBCs

Applicable requirements are those clean-up standards, standards of control, or other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law which specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site. Relevant and appropriate requirements are those Federal and/or State requirements that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. TBC criteria are non-promulgated advisories or guidance issued by Federal or State agencies that, although not legally binding, can be used in determining the level of clean-up for protection of health and the environment. The three types of ARARs are evaluated as part of the CERCLA process: chemical-specific, location-specific, and action-specific, are defined below.

4.1.1 Chemical-Specific ARARs

Chemical-specific ARARs are usually health- or risk-based numerical values which establish acceptable concentrations of chemicals which may be found in the ambient environment (EPA, 1988a). These values are usually presented for each individual compound or closely related group of compounds and do not consider mixtures of compounds, as are typically found at in active hazardous waste sites. In conjunction with an evaluation of site conditions (i.e., as performed in the risk assessment), values derived from chemical-specific ARARs aid in the development of site-specific clean-up goals for the site.

4.1.2 Location-Specific ARARs

Location-specific ARARs are requirements or restrictions placed on the conduct of activities or on chemical concentrations allowed to be released into the environment, based solely on the location of the site (EPA, 1988a). As an example, any actions to be taken at a site located on or near wetlands may be impacted by Federal and State wetland regulations.

4.1.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based criteria which affect actions taken with respect to hazardous wastes (EPA, 1988a). Specific requirements are determined based on the remedial action selected for the site. These requirements influence how the selected remedial activity is to be implemented.

4.2 ARAR Evaluation

The determination of ARARs/TBCs for the Site 2 RI/FS is based on a review of: (1) the types, quantities and extent of contaminants present at the site and (2) locational considerations of the site. Following this review, the universe of Federal and State requirements was examined and all chemical-specific and location-specific ARARs pertinent to the site were determined. Also identified were the additional State or Federal criteria and guidance (TBCs) which may provide useful information or recommended procedures. A discussion of action-specific ARARs is considered to be beyond the scope of this RI Report, because these ARARs relate generally to the implementation of a remedial action, which are typically developed as part of the FS process.

Table 4-1 presents a summary of the Federal and State chemical-specific ARARs for the Site 2 RI, along with a brief synopsis and determination regarding applicability or relevance to Site 2 for each criteria presented. Table 4-2 provides a similar discussion regarding location-specific ARARs pertinent to the Site 2 RI. Other criteria, advisories, and guidance to-be-considered are presented in Table 4-3. A general listing of aqueous chemical-specific ARAR and TBC concentration values pertinent to Site 2 are provided in Table 4-4. Tables 4-5 and 4-6 present soil ARARs for organics and inorganics, respectively. It should be noted that in addition to ARARs, Table 4-6 also presents site-specific background data for Site 2. These data were obtained through the evaluation of analytical results from the chemical analysis of samples collected from background locations.

Due to the absence of Federal or State promulgated standards for sediment, ARARS for this medium are not discussed in this section. Criteria for sediments are evaluated and presented in Section 8.0. The derivation of these site-specific background concentrations is presented in Section 6.2 of this report.

TABLE 4-1
SITE 2 CHEMICAL-SPECIFIC ARARS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ARARS	SYNOPSIS	EVALUATION
<i>Federal ARARs</i> 1. Ambient Water Quality Criteria (AWQC), Clean Water Act (CWA) CWA Section 304	Federal AWQC have been developed for 95 carcinogenic and non-carcinogenic compounds. AWQC for the protection of human health provide levels for exposure both from drinking the water and consumption of aquatic organisms (i.e. fish), and from consumption of fish alone. AWQC for the protection of aquatic life includes acute and chronic levels for freshwater and marine organisms.	Applicable. Should any remedial actions at Site 2 impact surface water or groundwater these actions must not cause the exceedance of AWQC.
2. Maximum Contaminant Concentrations (MCLs), Safe Drinking Water Act (SDWA) (40 CFR 141)	The SDWA MCLs are legally enforceable Federal drinking water standards, established by EPA. For non-carcinogens, the standards are based in part on the allowable lifetime exposure to each contaminant. MCLs apply to public water supply systems with at least 15 service connections.	Relevant and Appropriate. Due to the use of private residential wells east of Site 2, groundwater contaminant concentrations should not exceed MCLs.
3. National Ambient Air Quality Standards (NAAQS), Clean Air Act and the Clean Air Act Amendments (CAAA) (40 CFR 50)	The CAAA NAAQS are concentrations of sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead which, when exceeded may be detrimental to protect public health and welfare.	Applicable. Any remedial actions undertaken at Site 2 which involve gaseous emissions must comply with the CAAA NAAQS.
4. National Emissions Standards for Hazardous Air Pollutants (NESHAPS), CAAA (40 CFR 61)	The CAAA NESHAPS define acceptable concentrations of hazardous pollutants which may be emitted to the ambient air.	Applicable. Any remedial actions undertaken at Site 2 which involve gaseous emissions must comply with the CAAA NESHAPS.

TABLE 4-1, Continued
SITE 2 CHEMICAL-SPECIFIC ARARS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ARARS	SYNOPSIS	EVALUATION
<i>State ARARs</i>		
1. New York State Rules for Inactive Hazardous Waste Sites (6 NYCRR Subpart 375)	This regulation includes the New York State requirements for inactive hazardous waste sites.	Applicable. As Site 2 is an inactive hazardous waste site, this regulation applies.
2. New York State Water Quality Regulations (6 NYCRR Parts 700 through 705)	This regulation establishes the requirements for the State Pollutant Discharge Elimination System (SPDES) program. The SPDES provides the standards for surface and drinking water to protect human health and the environment. 6 NYCRR Parts 701 and 702 include surface water standards and 6 NYCRR Part 703 includes groundwater standards.	Applicable. Should any remedial action taken at Site 2 involve discharges to groundwater of surface water, the SPDES permit requirements must be met.
3. New York State Hazardous Waste Regulations (6 NYCRR Part 373)	This regulation includes the standards for groundwater monitoring for releases from solid waste management units.	Relevant and Appropriate. Remedial actions at Site 2 involving groundwater monitoring must comply with this regulation.
4. New York State Drinking Water Regulations (10 NYCRR Part 5; NYSDEC TOGS 1.1.1)	This regulation provides the New York State Department of Health drinking water quality standards. These regulations would apply to groundwaters used as drinking water supplies. Specific standards and guideline values are included in the guidance document TOGS 1.1.1.	Relevant and Appropriate. Although groundwater at Site 2 is not currently used as a drinking water source, private wells are located to the east of Site 2.
5. New York Air Quality Regulations (6 NYCRR Parts 256 and 257)	6 NYCRR Part 256 describes the State Air Quality Classification System. 6 NYCRR Part 257 includes ambient air quality standards.	Applicable. Any remedial actions taken at Site 2 involving gaseous emissions must comply with these regulations.

TABLE 4-2
SITE 2 LOCATION-SPECIFIC ARARS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ARARS	SYNOPSIS	EVALUATION
<p><i>Federal ARARs</i></p> <ol style="list-style-type: none"> 1. National Environmental Policy Act (NEPA); Protection of Wetlands, (Executive Order 11990), (40 CFR 6, Appendix A) 2. Endangered Species Act of 1973, 16 USC 1531 et seq. (50 CFR 81, 225, 402) 3. Migratory Bird Treaty Act of 1972 	<p>Appendix A of 40 CFR 6 sets forth policy for carrying out provisions of Protection of Wetlands Executive Order. Under this order, federal agencies are required to minimize the degradation, loss, or destruction of wetlands, and to preserve the natural and beneficial values of wetlands. Appendix A requires that no remedial alternative adversely affect a wetland if another practicable alternative is available. If no alternative is available, impacts from implementing the chosen alternative must be mitigated.</p> <p>This regulation requires that preventative measures be taken to ensure that no actions shall be performed which may jeopardize the continued existence of listed endangered or threatened species or modify their habitat.</p> <p>The Migratory Bird Treaty Act of 1972 implements many treaties involving migratory birds. This statute protects almost all species of native birds in the U.S. from unregulated "take" which can include poisoning at hazardous waste sites. The Act is a primary tool of the U.S. Fish and Wildlife Service and other Federal agencies in managing migratory birds.</p>	<p>Applicable. No wetland areas exist in the immediate vicinity of Site 2. However, there is a wetland area to the east, which could be impacted by actions taken downgradient of Site 2.</p> <p>Applicable. However, an inquiry to the New York State Wildlife Resources Center identified no listed endangered or threatened species at the Base.</p> <p>Applicable. No actions taken at Site 2 will adversely impact migratory birds.</p>

TABLE 4-3
SITE 2 OTHER CRITERIA, ADVISORIES AND GUIDANCE TO-BE-CONSIDERED
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

CRITERIA	SYNOPSIS	EVALUATION
<i>Federal TBC's</i>		
1. Environmental Protection Agency (EPA) Reference Doses (RfDs)	EPA RfDs are dose levels developed for non-carcinogenic effects used to characterize risks of groundwater contamination. They are considered levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	EPA RfDs are typically used to perform a Baseline Risk Assessment (BRA), as presented in Section 8.0 of this Report. These values may also be used to evaluate any potential remedial actions.
2. EPA Carcinogen Assessment Group - Potency Factors (CAGs)	EPA CAGs were developed from Health Effects Assessments (HEAs), or evaluations by the Carcinogen Assessment Group, and present the most up-to date cancer risk potency information.	EPA CAGs are typically used to perform a BRA, as presented in Section 8.0 of this Report. These values may also be used to evaluate any potential remedial actions.
3. EPA Health Advisories (Office of Drinking Water)	EPA Health Advisories are estimates of non-carcinogenic risks due to consumption of contaminated drinking water.	EPA Health Advisories may be evaluated in determining clean-up goals any remedial actions at Site 2.
<i>State TBCs</i>		
1. NYSDEC TAGM HWR-94-4046	This guidance document provides non-promulgated criteria which may be used to establish site-specific cleanup goals.	This document will be used to determine appropriate clean-up goals for soil.
2. NYSDEC Air Guide 1	This document provides guidance for the control of toxic ambient air concentrations in New York State.	This document may be useful in establishing the allowable gaseous emissions from any remedial action at Site 2.

TABLE 4-4
SITE 2 - CHEMICAL-SPECIFIC ARARs AND TBCs - WATER
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETERS	FEDERAL SDWA			NEW YORK DWQS (b)	FEDERAL AWQC HUMAN HEALTH (c)		FEDERAL AWQC AQUATIC LIFE (c)		NEW YORK STATE AWQC (d)	
	MCLs (a)	MCLGs (a)	SECONDARY MCLs (a)		W & F	F	ACUTE	CHRONIC	AQUATIC	HUMAN HEALTH
pH (standard units)			6.5-8.5	6.5-8.5				6.5-9	6.5-8.5	
Alkalinity (mg/L as CaCO ₃)										
Total Dissolved Solids (mg/L)			500		250				500	
Common Anions (mg/L)										
Bromide										2 WS
Chloride			250	250			860	230		250 WS
Fluoride	4	4	2	2.2					0.23	1.5 WS
Nitrate (as nitrogen)	10	10		10	10					10 WS
Nitrite (as nitrogen)	1	1		1					0.02	
Sulfate	400	400	250	250						250 WS
Metals (mg/L)										
Aluminum			0.05		e		e		0.1	
Antimony	0.006	0.006			0.014	45	0.088	0.03		0.003 WS
Arsenic	0.05	0.05		0.05	2E-06	0.0001	0.36 g	0.19 g	0.19	0.05 WS
Barium	1	2		2	1					1 WS
Beryllium	0.004	0.004			8E-06	0.0001	0.13	0.005	1.1	0.003 WS
Cadmium	0.01	0.005		0.005	0.01	0.17	0.0039 h	0.001 h	0.001 h	0.01 WS
Chromium (VI)	0.05	f	f	0.01	0.17	3.4	0.016	0.011 h	0.011	0.05 WS
Chromium (III)	0.05	f	f	0.01	33		1.7 h	0.21 h	1.74 h	0.05 WS
Copper	1.3	1.3	1	0.13	1.3		0.018 h	0.012 h	0.012 h	0.2 WS
Iron			0.3	0.3	0.3			1	0.3	0.3 WS
Lead	0.05	0		0.015	0.05		0.082 h	0.0032 h	0.003 h	0.05 WS
Manganese				0.3	0.05	0.1				0.3 WS
Mercury	0.002	0.002	0.05	0.002	0.0001	0.0002	0.0024 h	0.00001		0.0002 B
Nickel	0.1	0.1			0.51	3.8	1.4 h	0.16 h	0.096 h	
Phosphorus										
Selenium	0.01	0.05		0.01	0.104	6.8	0.02	0.005	0.001	0.01 WS
Silver	0.05		0.1	0.05	0.091		0.00092 h	0.00012	0.0001	0.05 WS
Thallium	0.002	0.0005			0.0017	0.006	1.4	0.04	0.008	0.004 WS
Vanadium									0.014	
Zinc			5	5		10	0.12	0.11	0.03	0.3 WS
Cyanide	0.2	0.2			0.7	21.5	0.022	0.0052	0.052	0.1 WS

TABLE 4-4, (cont.)
 SITE 2 - CHEMICAL-SPECIFIC ARARs AND TRCs - WATER
 STEWART AIR NATIONAL GUARD BASE
 NEWBURGH, NEW YORK

PARAMETERS	FEDERAL SDWA			NEW YORK		FEDERAL AWQC		FEDERAL AWQC		NEW YORK STATE	
	MCLs (a)	MCLGs (a)	SECONDARY MCLs (a)	DWQS (b)	HUMAN HEALTH (c)	W & F	F	ACUTE	CHRONIC	AQUATIC	HUMAN HEALTH
Volatile Organics (ug/L)											
Benzene	5	0		5 i	1.2	71		5300			0.7 WS
Chlorobenzene	100	100		5 i	680	21000		250 j	50 j	5	20 WS
Ethylbenzene	700	700		5 i	3100	29000		32000			5 WS
Toluene	1000	1000		5 i	10000	300000		17500			5 WS
Xylenes (total)	10000	10000		5 i							5 WS
Semivolatile Organics (ug/L)											
1,2-Dichlorobenzene	600	600		5 i	2700	17000		1120	763	5	20 WS
1,3-Dichlorobenzene				5 i	400	2600		1120	763	5	20 WS
1,4-Dichlorobenzene	75	75		5 i	400	2600		1120	763	5	30 WS
1,2,4-Trichlorobenzene	70	70		50 k				250 j	50 j	5	10 WS
Acenaphthene				50 k	1200	2700		1700	520		20 WS
Anthracene				50 k	0.0028	0.0311					50 WS
Benz(a)anthracene	5	0		50 k	0.0028	0.0311					0.002 WS
Benzo(b)fluoranthene	7.5	0		50 k	0.0028	0.0311					0.002 WS
Benzo(k)fluoranthene	7.5	0		50 k	0.0028	0.0311					0.002 WS
Benzo(g,h,i)perylene				50 k	0.0028	0.0311					
Benzo(a)pyrene	0.2	0		50 k	0.0028	0.0311					ND WS
Chrysene	5	0		50 k	0.0028	0.0311					0.002 WS
Dibenz(a,h)anthracene	13	0		50 k	0.0028	0.0311					
Dibenzofuran				50 k							
Fluoranthene				50 k	42	54		3980			50 WS
Fluorene				50 k	0.0028	0.0311					50 WS
Indeno(1,2,3-c,d)pyrene	13	0		50 k	0.0028	0.0311					0.002 WS
2-Methylnaphthalene				50 k							
Naphthalene				50 k				2300	620		10 WS
Phenanthrene				50 k	0.0028	0.0311		30	6.3		50 WS
Pyrene				50 k	0.0028	0.0311					50 WS

TABLE 4-4, (cont.)
 SITE 2 - CHEMICAL-SPECIFIC ARARs AND TBCs - WATER
 STEWART AIR NATIONAL GUARD BASE
 NEWBURGH, NEW YORK

PARAMETERS	FEDERAL SDWA			NEW YORK DWQS (b)	FEDERAL AWQC HUMAN HEALTH (c)		FEDERAL AWQC AQUATIC LIFE (c)		NEW YORK STATE AWQC (d)	
	MCLs (a)	MCLGs (a)	SECONDARY MCLs (a)		W & F	F	ACUTE	CHRONIC	AQUATIC	HUMAN HEALTH
PCBs/Pesticides (ug/L)										
PCBs	0.5	0		0.5	4E-05	5E-05	2	0.014	0.001	6E-07 B
Aldrin				50 k	0.0001	0.0001	3			0.002 WS
Bromacil				4.4						
Chlordane	2	0		2	0.0006	0.0006	2.4	0.0043		0.002 B
p,p'-DDD				50 k			0.06		0.001	0.01 WS
p,p'-DDE				50 k	0.0006	0.0006	1050		0.001	0.01 WS
p,p'-DDT				50 k	0.0006	0.0006	1.1	0.001	0.001	0.01 WS
Dieldrin				50 k	0.0001	0.0001	2.5	0.0019	0.001	0.0009 WS
Endosulfan B				50 k	0.93	2	0.22	0.056	0.009	
Endrin	2	2		0.2	0.76	0.81	0.18	0.0023		0.002 B
Heptachlor	0.4	0		0.4	0.0002	0.0002	0.52	0.0038	0.001	0.009 WS
Heptachlor epoxide	0.2	0		0.2	0.0001	0.0001	0.52	0.0038	0.001	0.009 WS
Chlorinated Herbicides (ug/L)										
2,4-D	70	70		50	100					
2,4-DB				50 k						
2,4,5-T				10						
2,4,5-TP (Silvex)	50	50		50 k	10					
Dalapon	200	200		50						50 WS
Dicamba				0.44						
Dichloroprop				50 k						
Dinoseb	7	7		50 k						1 WS
MCPA				50 k						
MCPP				50 k						

TABLE 4-4, (cont.)
SITE 2 - CHEMICAL-SPECIFIC ARARs AND TBCs - WATER
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

Notes

SDWA = Safe Drinking Water Act.
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
DWQS = New York Primary Drinking Water Quality Standard
AWQC = EPA ambient water quality criteria.
W & F = AWQC for the protection of human health from the ingestion of water and aquatic organisms.
F = AWQC for the protection of human health from the ingestion of aquatic organisms, only.
WS = water source
HB = bioaccumulation
POC = Principle Organic Contaminant
PCB = polychlorinated biphenyl.
p,p'-DDD = 1,1-dichloro-2,2-bis-(p-chlorophenyl)ethane.
p,p'-DDE = 1,1-dichloro-2,2-bis-(p-chlorophenyl)ethene.
p,p'-DDT = 1,1,1-trichloro-2,2-bis-(p-chlorophenyl)ethane.
CaCO₃ = calcium carbonate.
mg/L = milligrams per liter.
ug/L = micrograms per liter.

Secondary MCLs are not potential ARARs but are To Be Considered (TBCs) and have been included for comparison purposes only.

- (a) Drinking Water Regulations and Health Advisories, EPA, May 1994
- (b) 10 NYCRR Part 5
- (c) Water Quality Criteria Summary, USEPA, 1991.
- (d) 6 NYCRR Parts 701-705, and NYS TOGS 1.1.1, November 15, 1991.
- (e) pH Dependent Criteria
- (f) Value for total chromium.
- (g) Value for trivalent arsenic.
- (h) Hardness-dependent criteria assumes water hardness of 100 mg/L calcium carbonate.
- (i) Value for listed principle organic contaminants; total for principle ad unspecified organic contaminants may not exceed 100 ug/L.
- (j) Value for total chlorinated benzenes.
- (k) Value for listed unspecified organic contaminants; total for principle and unspecified organic contaminants may not exceed 100 ug/L.

TABLE 4-5
CHEMICAL-SPECIFIC ARARs AND TBCs AT SITE 2
SOILS - ORGANICS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETERS	PARTITION COEFFICIENT K _{oc}	GROUNDWATER CRITERIA C _w (ppb)	ALLOWABLE SOIL CONCENTRATION C _s (ppm)	SOIL CRITERIA (a)		
				EPA HEALTH BASED		NYSDEC SOIL CLEANUP GOALS (ppm)
				CARCINOGENS (ppm)	SYSTEMIC TOXICANTS (ppm)	
Volatile Organics (mg/kg)						
2-Butanone	4.50	50	0.0016	NA	4,000	0.16 c,d
Benzene	83	0.7	0.0004	24	NA	0.04 c,d
Carbon Disulfide	54	50	0.0194	NA	8,000	1.94 c,d
Chlorobenzene	330	5	0.0119	NA	2,000	1.19 c,d
Chloroform	31	7	0.0016	114	800	0.16 c,d
Ethylbenzene	1,100	5	0.0396	NA	8,000	3.96 c,d
Methylene Chloride	21	5	0.0008	93	5,000	0.08 c,d
Toluene	300	5	0.0108	NA	20,000	1.08 c,d
Total Xylenes	240	5	0.0086	NA	200,000	0.86 c,d
Semivolatile Organics (mg/kg)						
2,4-Dichlorophenol	380	1	0.0027	NA	200	0.27 c,e
2-Methylnaphthalene	727	50	0.2617	NA	NA	26.17 c,e
Benzo(a)anthracene	1,380,000	0.002	0.0199	0.2240	NA	0.224 or MDL c,e
Benzo(a)pyrene	5,500,000	0.002	0.0792	0.0608	NA	0.0609 or MDL c,e
Benzo(b)fluoranthene	550,000	0.002	0.0079	NA	NA	0.79 c,e
Benzo(k)fluoranthene	550,000	0.002	0.0079	NA	NA	0.79 c,e
Benzo(g,h,i)perylene	1,600,000	5	57.60	NA	NA	50 c,e
Bis(2-ethylhexyl)phthalate	8,706	50	3.13	50	2,000	50 c,e
Carbazole	NA	NA	NA	NA	NA	50 c,e
Chrysene	200,000	0.002	0.0029	NA	NA	0.29 c,e
Dibenz(a,h)anthracene	33,000,000	50	11880	0.0143	NA	0.014 or MDL c,e
Di-n-butylphthalate	162,000	50	0.0583	NA	8,000	5.83 c,e
Fluoranthene	38,000	50	13.88	NA	3,000	50.00 c,e
Indeno(1,2,3-cd)pyrene	1,600,000	0.002	0.0230	NA	NA	2.30 c,e
Naphthalene	1,300	10	0.0936	NA	300	9.38 c,e
Phenanthrene	4,365	50	1.5714	NA	NA	50.00 c,e
Pyrene	13,295	50	4.7862	NA	2,000	50.00 c,e
Pesticides (mg/kg)						
Chlordane	21,305	0.1	0.0153	0.54	50	0.54 c,f
p,p'-DDD	770,000	<0.01	0.0554	2.90	NA	2.90 c,f
p,p'-DDE	440,000	<0.01	0.0317	2.10	NA	2.10 c,f
p,p'-DDT	243,000	<0.01	0.0175	2.10	40	1.75 c,f
Dieldrin	10,700	<0.01	0.0008	0.04	4	0.04 c,f

NOTES

- (a) NYSDEC TAGM HWR-94-4046, January 24, 1994.
 (b) NYSDEC Sediment Criteria
 (c) Values are TOC dependent. Values presented in this table are based on a mean TOC value of 0.72% for soils and 1.16% for sediment.
 (d) Total VOCs in soil should not exceed 10 ppm.
 (e) Total VOCs in soil should not exceed 500 ppm. Individual SVOCs should not exceed 50 ppm.
 (f) Total Pesticides in soil should not exceed 10 ppm.
 (g) Value is for total of Aldrin and Dieldrin.
 * - Partition coefficient is calculated by using the following equation:
 $\log K_{oc} = -0.55 \log S + 3.64$ - where S is water solubility in ppm
 ug/L = micrograms per liter.

ABBREVIATIONS

MDL - Method Detection Limit
 NA - Not Available
 ND - Non Detect
 PCB - polychlorinated biphenyl.
 ppb - parts per billion
 p,p'-DDD - Dichlorodiphenyldichloroethane
 p,p'-DDE - Dichlorodiphenyldichloroethene
 p,p'-DDT - Dichlorodiphenyltrichloroethane
 ppm - parts per million
 mg/kg = milligrams per kilogram
 ug/L = micrograms per liter.

TABLE 4-6
CHEMICAL-SPECIFIC ARARs AND TBCs AT SITE 2
SOILS - INORGANICS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETERS	SOIL CRITERIA (a)	
	SITE-SPECIFIC BACKGROUND CONCENTRATION (ppm)	NYSDEC SOIL CLEANUP OBJECTIVES (ppm)
Aluminum	11900	SB
Antimony	14.6	SB
Arsenic	6.2	7.5 or SB
Barium	53.8	300 or SB
Beryllium	0.96	0.16 or SB
Cadmium	ND	1 or SB
Calcium	23400	SB
Chromium	17.5	10 or SB
Cobalt	11.8	30 or SB
Copper	28.0	25 or SB
Iron	24800	2000 or SB
Lead	12.5	SB
Magnesium	7190	SB
Manganese	623	SB
Mercury	ND	0.1
Nickel	24.9	13 or SB
Potassium	1394	SB
Selenium	ND	2 or SB
Silver	1.30	SB
Sodium	49.7	SB
Thallium	1.10	SB
Vanadium	14.5	150 or SB
Zinc	63.2	20 or SB

ABBREVIATIONS

ND - Not-Detected
NA - Not Available
ppm - parts per million
SB - Site Background

NOTES

(a) NYSDEC TAGM HWR-94-4046, January 24, 1994

SECTION 5.0

5.0 FIELD PROGRAM

This section presents a general discussion of the field program implemented as part of the Site 2 RI. Section 5.1 presents a summary of the overall approach to the RI field program. Deviations from the approved RI workplan (Aneptek, 1995) are listed in Section 5.2. Sections 5.3, 5.4, and 5.5 present general descriptions of the on-site screening and sampling and analysis performed during the field program at Site 2.

5.1 Summary

The field program was implemented in accordance with the RI/FS Work Plan (Aneptek, 1995), except as noted in Section 5.14, Deviations from the Work Plan. The planned and executed field programs are summarized on Table 5-1. A summary of sampling intervals and associated analyses is presented on Table 5-2. The initial mobilization for the field program started on September 7, 1995 and ended December 6, 1995. A second mobilization to perform the second round of groundwater sampling occurred from March 19 through 21, 1996.

5.1.1 Objectives

The field program was designed to achieve the following objectives:

- confirm the former location of the pit,
- evaluate subsurface soils for potential residual contamination near the location of the former burial pit,
- evaluate surface soils and sediment around and downgradient of Site 2 for residual contamination,
- evaluate groundwater quality in the overburden and bedrock aquifers adjacent to and downgradient of Site 2, and
- evaluate groundwater quality and potential for contaminant migration downgradient of Site 1.

5.1.2 Approach

The field program included geophysical surveys, advancement of soil borings, installation of groundwater monitoring wells, and collection of surface and subsurface soils, sediment, and groundwater samples for chemical analysis. All samples were submitted to an off-site laboratory for chemical analysis for TCL VOCs and SVOCs, pesticides and PCBs, and TAL metals and cyanide. All soil samples were analyzed for TOC, all subsurface soil samples were screened onsite for total VOCs with an HNu[®] photoionization detector (PID) and for total pesticides using an immuno assay test. The sample from each soil boring with the highest field screening levels, and the last sample collected was submitted to the off site laboratory for chemical analysis in

TABLE 5-1
SITE 2 PLANNED AND EXECUTED FIELD PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PLANNED FIELD PROGRAM					EXECUTED FIELD PROGRAM		
FIELD ACTIVITY	NO. OF SAMPLES	ANALYSES	DOO	RATIONALE	NO. OF SAMPLES	ANALYSES	RATIONALE
Monitoring Well Installation (5 locations)	NA	NA	NA	Install five new monitoring wells. MW-01 planned as a background well. MW-02 and MW-03 planned as overburden pairs adjacent to existing wells SW-02 and SW-03. MW-04 and MW-05 planned as a downgradient overburden/bedrock well pair.	NA	NA	Four wells installed. MW-01 completed in bedrock. MW-02 and MW-03 not installed due to presence of soil contamination in borehole. MW-13 installed as an overburden well in lieu of these wells. MW-09 and MW-10 installed as downgradient well pair.
Groundwater Sampling	18 18 18 18 18 18	TCL VOCs TCL SVOCs Pest/PCBs TAL Total Metals TAL Dissolved Metals Cyanide	Level IV Level IV Level IV Level IV Level IV Level IV	To determine the nature and extent of groundwater contamination, samples to be collected during two sampling rounds from nine wells: five new wells (MW-01 through MW-05) and four existing wells (SW-02, SW-03, JMW-108 and JMW-109). MW-01 will be the background well.	16 16 16 16 16 16	TCL VOCs TCL SVOCs Pest/PCBs TAL Total Metals TAL Dissolved Metals Cyanide	One less overburden well installed than planned due to presence of contamination in well boreholes.
Investigation-Derived Waste Sampling	3 3 3 3	TCLP VOCs TCLP SVOCs TCLP Pest/PCBs TCLP Metals	Level III Level III Level III Level III	All soils to be drummed and analyzed for determination of disposal requirements.	4 4 4 4	TCLP VOCs TCLP SVOCs TCLP Pest/PCBs TCLP Metals	All drummed soils analyzed as specified in the Work Plan.
Habitat Survey	NA	NA	NA	Evaluate flora, fauna and cover for ecological risk assessment.	NA	NA	Evaluation performed as specified in the Work Plan.
Surveying	NA	NA	NA	All surface soil, sediment, soil borings and monitoring wells to be surveyed by a licensed surveyor.	NA	NA	Surveying performed as specified in the Work Plan.
Hydrogeologic Testing	Not Determined 5	Water Level Measurements In Situ Permeability (Slug) Tests	Level I Level I	Water level measurements to determine flow direction and local horizontal gradient. Slug tests to provide an estimate of hydraulic conductivity of shallow aquifer.	NA 4	Water Level Measurements In Situ Permeability (Slug) Tests	Water levels measured during three rounds, occurring 12/8/95, 3/19/96 and 4/9/96. Levels measured in all new and existing wells, piezometers and staff gages. Slug tests performed on all new wells

ABBREVIATIONS

NA - Not Applicable
 MET/CYN - TAL Metals and Cyanide
 TAL - Target Analyte List
 TCL - Target Compound List
 TCL VOC - TCL Volatile Organic Compounds
 TCL SVOC - TCL Semivolatile Organic Compounds
 Pest/PCB - Pesticides and Polychlorinated Biphenyls
 DQO - Data Quality Objective

TABLE 5-1 (cont.)
SITE 2 PLANNED AND EXECUTED FIELD PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PLANNED FIELD PROGRAM					EXECUTED FIELD PROGRAM		
FIELD ACTIVITY	NO. OF SAMPLES	ANALYSES	DQO	RATIONALE	NO. OF SAMPLES	ANALYSES	RATIONALE
Geophysical Survey	NA	NA	NA	Attempt to identify approximate location of Site 2 by detecting the buried "H" beams used to shore the original excavation. An electromagnetic survey over a grid of 160 by 60 feet was planned, with readings obtained on 20-foot spacing.	NA	NA	Electromagnetic survey was inconclusive, so it was followed up with a ground penetrating radar survey over the same survey area and a test pit excavation to confirm the results of the surveys.
Surface Soil Sampling (7 Locations & 1 duplicate)	7 7 7 7 7	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC	Level IV Level IV Level IV Level IV Level III	Characterize nature and extent of surface soil contamination. Samples obtained from the 0-2 foot interval of each soil boring advanced. Samples from SB-01 and MW-01 designated the background sample.	7 7 7 7 7	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC	Samples collected as specified in the Work Plan.
Sediment Sampling (7 Locations & 1 duplicate)	7 7 7 7 7	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC	Level IV Level IV Level IV Level IV Level III	Characterize potential for contaminant migration via sediment transport and determine the extent of sediment contamination downgradient of Site 2 in drainage swale, upgradient pond area and in overland runoff areas on the slope east of Site 2. Samples to be collected from two background locations and six downgradient locations.	7 7 7 7 7	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC	<ul style="list-style-type: none"> • SS-01 and SS-03 collected as background samples. • SS-02 and SS-05 collected from within the swale and ponded areas. • SS-04 and SS-07 along downgradient drainage pathways at locations specified by NYDOH on 8/3/95. • SS-06 collected at the same location as SI sample SS-11, which had the highest levels observed during the SI.
Subsurface Soil Sampling (7 Locations)	14 14 14 14 14 120	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC Total Pesticides	Level IV Level IV Level IV Level IV Level III Level II	Define nature and extent of residual subsurface soil contamination, define site geology around Site 2 area. Two samples from SB-01 proposed for background samples. All samples screened for VOCs with a PID and Total Pesticides with an immunoassay field test. Samples from first and last sampled intervals as well as most contaminated intervals submitted for laboratory analysis.	20 20 20 20 20 77	TCL VOCs TCL SVOCs Pest/PCBs TAL MET/CYN TOC Total Pesticides	Additional samples collected from MW-01 for background sample purposes. Samples from borings for MW-02 and MW-03 due to screening detections of pesticides. Soil borings SB-02 thru SB-05 were advanced to a depth of approximately 20 feet bgs around the confirmed former location of the burial pit. Soil borings SB-06 and SB-07 were advanced along the downgradient side of the pit to the surface of weathered bedrock.

TABLE 5 - 2
SITE 2 LABORATORY ANALYTICAL SAMPLING PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE ID ¹	VOCs	SVOCs	PEST/PCBs	METALS CYANIDE	TOC	NOTES	SAMPLE ID ¹	VOCs	SVOCs	PEST/PCBs	METALS CYANIDE	TOC	NOTES
Surface Soil							Sediment						
MW-01-04	•	•	•	•	•	Background	SS-01	•	•	•	•	•	Background
SB-01-02	•	•	•	•	•	Background	SS-02	•	•	•	•	•	Background
SB-02-02	•	•	•	•	•		SS-03	•	•	•	•	•	
SB-03-1.3	•	•	•	•	•		SS-04	•	•	•	•	•	
SB-04-02	•	•	•	•	•		SS-05	•	•	•	•	•	
SB-05-02	•	•	•	•	•		SS-06	•	•	•	•	•	
SB-06-02	•	•	•	•	•		SS-07	•	•	•	•	•	Dup. of SS-05
SB-07-02	•	•	•	•	•		SS-15	•	•	•	•	•	
Subsurface Soil							Groundwater						
MW-01-18	•	•	•	•	•	Background	MW-01-1128	•	•	•	•	•	
MW-01-31.6	•	•	•	•	•	Background	SW-02-1128	•	•	•	•	•	
SB-01-18.5	•	•	•	•	•	Background	SW-12-1128	•	•	•	•	•	Dup. of SW-02-1128
SB-01-32.5	•	•	•	•	•	Background	SW-03-1128	•	•	•	•	•	
SB-02-06	•	•	•	•	•		MW-09-1127	•	•	•	•	•	
SB-02-10.2	•	•	•	•	•		MW-10-1128	•	•	•	•	•	
SB-03-06	•	•	•	•	•		JMW-108-1128	•	•	•	•	•	
SB-03-56	•	•	•	•	•	Dup. of SB-03-06	JMW-109-1128	•	•	•	•	•	
SB-03-22	•	•	•	•	•		MW-13-1128	•	•	•	•	•	
SB-04-06	•	•	•	•	•		MW-10-1128	•	•	•	•	•	
SB-04-21	•	•	•	•	•		MW-01-0320	•	•	•	•	•	
SB-05-06	•	•	•	•	•		SW-02-0320	•	•	•	•	•	
SB-05-22	•	•	•	•	•		SW-12-0320	•	•	•	•	•	
SB-06-26.5	•	•	•	•	•		SW-03-0321	•	•	•	•	•	
SB-06-34.5	•	•	•	•	•		MW-09-0321	•	•	•	•	•	
SB-07-16	•	•	•	•	•		MW-10-0321	•	•	•	•	•	
SB-07-33	•	•	•	•	•		JMW-108-0321	•	•	•	•	•	
SB-17-33	•	•	•	•	•	Dup. of SB-07-33	JMW-109-0321	•	•	•	•	•	
MW-02-17	•	•	•	•	•		MW-13-0320	•	•	•	•	•	
MW-02-31	•	•	•	•	•								
MW-03-22	•	•	•	•	•								
MW-03-32	•	•	•	•	•								

ABBREVIATIONS

TOC - Total Organic Carbon Dup. - Duplicate Sample

VOCs - Volatile Organic Compounds

SVOCs - Semivolatile Organic Compounds

Pest/PCBs - Pesticides/Polychlorinated Biphenyls

NOTES

1. Last four digits of groundwater sample Identification Number indicates date sampled for November 1995 and March 1996.

2. All groundwater samples were analyzed for both total and dissolved metals (unfiltered and filtered).

accordance with New York State CLP Protocols.

All off-site laboratory analyses were performed by EnviroTest Laboratories, a New York State CLP certified laboratory. Analyses were performed in accordance with New York State CLP protocols. The following analytical methods were used:

- VOCs -New York State CLP Method 91.1
- SVOCs -New York State CLP Method 91.2
- Pesticides/PCBs -New York State CLP Method 91.3
- TAL Metals and Cyanide -New York State CLP TAL Metals/Cyanide Methods
- TOC -New York State CLP March 1986 Method.

All sample data received from the laboratory was subjected to third party validation in accordance with current EPA Region II validation guidelines (EPA, 1992a and EPA, 1992b).

5.2 Deviations from the Work Plan

The following is a summary of deviations from the Work Plan. Field change request forms are presented in Appendix B.

- A GPR survey was performed over the location of the former pit. This additional survey was performed because the EM survey was unable to conclusively confirm the location of the pit.
- An exploratory test pit was excavated along the edge of the former location of the pit. This test pit was excavated after the data collected during the EM and GPR surveys had been reviewed and found to be inconclusive.
- Three additional soil samples were collected from the soil boring advanced for the construction of MW-01 and submitted to the off-site laboratory for chemical analysis. The additional samples were collected to ensure a sufficient amount of site-specific background data were obtained.
- Two (2)-inch inside diameter (ID) monitoring wells were installed, instead of 4-inch ID as proposed in the Work Plan. Drilling the borehole for a 4-inch well was not practical due to the tightness of the subsurface material. The reduction of the well diameter did not affect the overall quality of the program.
- Groundwater monitoring wells MW-02 and MW-03 were not installed. During the advancement of the soil borings for these wells, pesticide screening data indicated the presence of contaminated subsurface soils. In accordance with Air National Guard Site Investigation Protocols (ANGSIP), no wells were installed within the contaminated areas. Additional soils samples from these boreholes were submitted for laboratory analysis because of these screening detections.

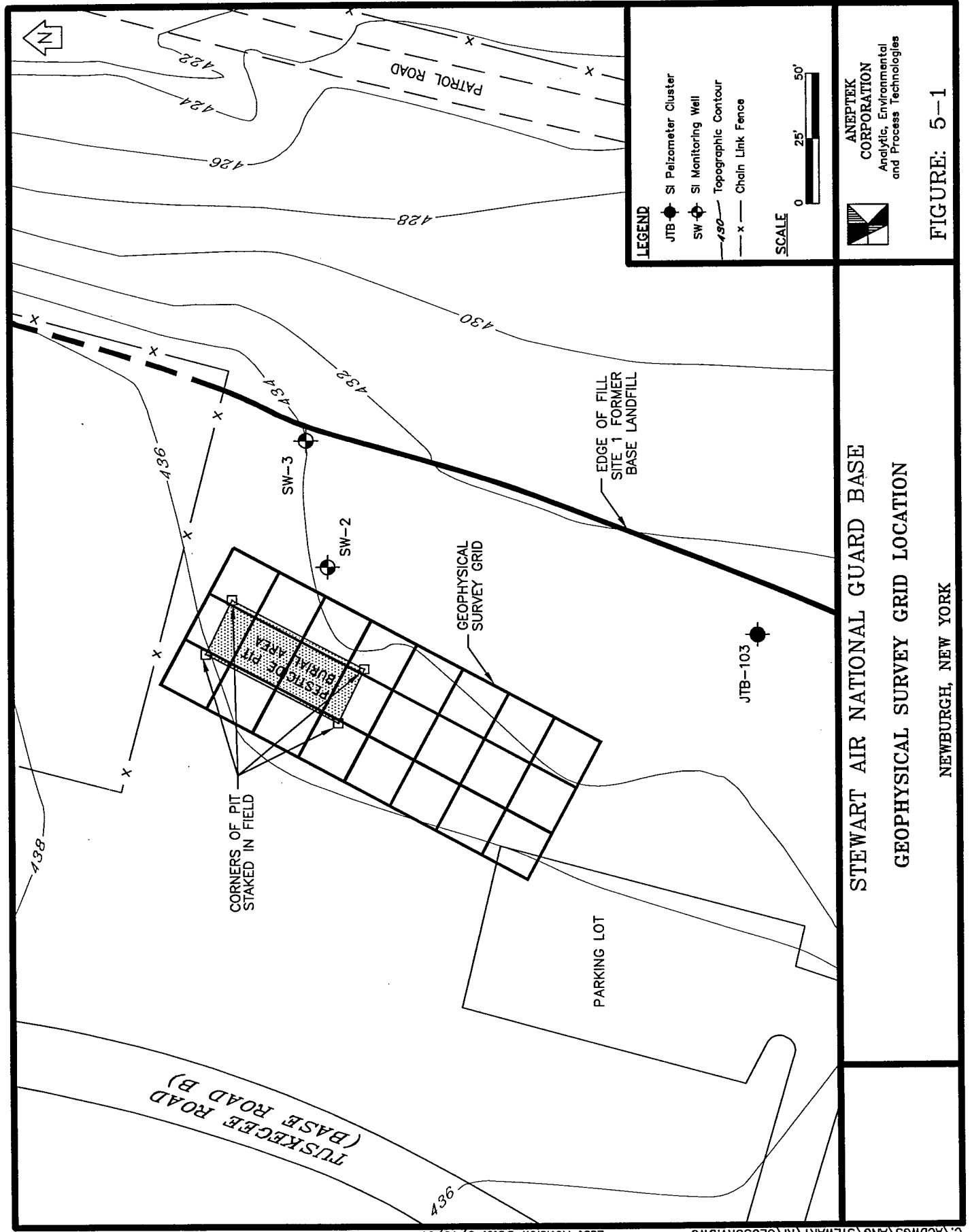
- An additional groundwater monitoring well (MW-13) was installed and sampled. Because MW-02 and MW-03 were not installed, MW-13 was added to the program to facilitate the collection and chemical analysis of groundwater within the overburden in the vicinity of the PPBA.
- The borehole abandonment procedure for borings advanced into the weathered fractured shale was altered in the field to include placing #00-Morie sand within the portion of the boring which penetrated the weathered fractured shale. The remainder of the boring was then abandoned in accordance with the approved Work Plan. This change was made to prevent localized changes in groundwater pH induced by the bentonite grout within the weathered fractured shale, because monitoring wells were planned less than 50 feet downgradient of these soil boring locations.
- The glassware supplied by the off site laboratory for soil sample collection differed from that specified in the Work Plan. Glassware used for soil sample collection included two 40-milliliter (ml) glass vials with teflon-lined septa for VOCs and one 8-ounce (oz) wide mouth glass jar with teflon-lined septa for other analytes. Stainless steel liners were not used for VOC samples as originally specified in the Work Plan.
- Decontamination procedures were altered so that the nitric acid rinse was performed prior to the methanol rinse. This change was made to ensure decontamination was performed in accordance with the EPA Region II Quality Assurance Manual (EPA, 1989).

5.3 Field Screening Activities

In accordance with the Work Plan (Aneptek, 1995), field screening activities performed at Site 2 consisted of geophysical surveys and soil screening using both a PID and an immuno assay test. Each of these activities is briefly discussed below.

5.3.1 Geophysical Investigation

A remote sensing geophysical investigation was performed in order to locate the limits of the PPBA. Two methods were employed, EM and GPR. Figure 5-1 illustrates the geophysical survey grid used for Site 2. The geophysical surveys were conducted on a 60 x 160-foot grid with 20-foot spacing between survey points. The grid was positioned over the reported location of the former pit as shown on a drawing provided by Base personnel which had been prepared by Geo-Con, Inc., dated July 7, 1988. This drawing provided measured distances from a nearby storm drain, manhole cover, and from SW-2 as references for locating the pit. Using this information, the four corners of the pit were located and the geophysical grid laid out in accordance with the Work Plan.



Last Revision Date: 3/19/97

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5.3.1.1 Electromagnetic Survey

An EM survey was performed at Site 2 over the reported location of the former burial pit to locate the buried "H"-piles that were left in the ground after completion of the removal action. The EM survey at Site 2 was performed by Geophysics GPR International, Inc. (Geophysics GPR) using a Geonics EM-31 Terrain Conductivity Meter. Details of this survey and the EM-31's operational theory are provided in Appendix H. A Geophysics GPR geophysicist performed the survey by walking over the survey grid pattern, and taking EM readings at 5-foot intervals. The resulting data were then plotted on a map of the survey area, in order to identify areas of anomalous changes in the magnetic field which would correlate with the reported location of the burial pit.

5.3.1.2 Ground Penetrating Radar Survey

A GPR survey was also performed at Site 2 by Geophysics GPR using a GSSI SIR-3 radar system with 100-megahertz (Mhz) and 500-Mhz antennas. GPR was used to identify the burial pit as an area expected to be somewhat less compact than the surrounding ground, or possibly to identify the buried "H"-piles. This survey was added to the field program because the EM survey did not clearly identify the location of the "H"-piles. Details of this survey and the SIR-3 operational theory are provided in Appendix H. The GPR survey at Site 2 was conducted by slowly pulling the antenna over a portion of the same survey grid used for the EM survey (Figure 5-1). The survey was monitored by a geophysicist, and an attempt was made to identify anomalies which correlated with the identified location of the pit.

5.3.2 Soil Screening

5.3.2.1 PID Screening

An HNu[®] PID with a 10.2 electronvolt (eV) lamp was used to screen subsurface soil samples for total VOCs. A PID uses an ultraviolet lamp to ionize airborne VOC vapors that enter an ionization chamber within the instrument. The ionized vapor then passes an ionization detector, providing a relative reading of the quantity of VOCs present in the air.

Aneptek personnel performed the PID screening on each soil sample immediately upon opening the subsurface soil sampler. Once the sampler was open, Aneptek personnel passed the PID probe longitudinally over the recovered sample. Field personnel then separated the soils in the sampler with a stainless steel scoopula and placed the PID probe near the center of the sample to take a reading. All readings were noted on the soil boring logs.

5.3.2.2 Immuno Assay Screening

Pesticide immuno assay screening of all subsurface soils was performed during the RI to provide an indication of the relative pesticide concentrations in the soils and to aid in the selection of samples to be submitted to the off-site laboratory for chemical analysis. The immuno assay

screening test kit used for the Site 2 RI was designed by Millipore Corporation to detect DDT in soils. The analysis was performed in accordance with Standard Operating Procedure No. 12 in Appendix C of the Work Plan (Aneptek, 1995). Details of the theory and test method are provided in Appendix I.

5.4 Confirmatory Activities

In accordance with the approved RI workplan confirmatory activities conducted during Site 2 RI field program included the advancement of soil borings, the installation of groundwater monitoring wells, and the sampling and analysis of surface and subsurface soils, sediments, and groundwater.

5.4.1 Exploratory Test Pit

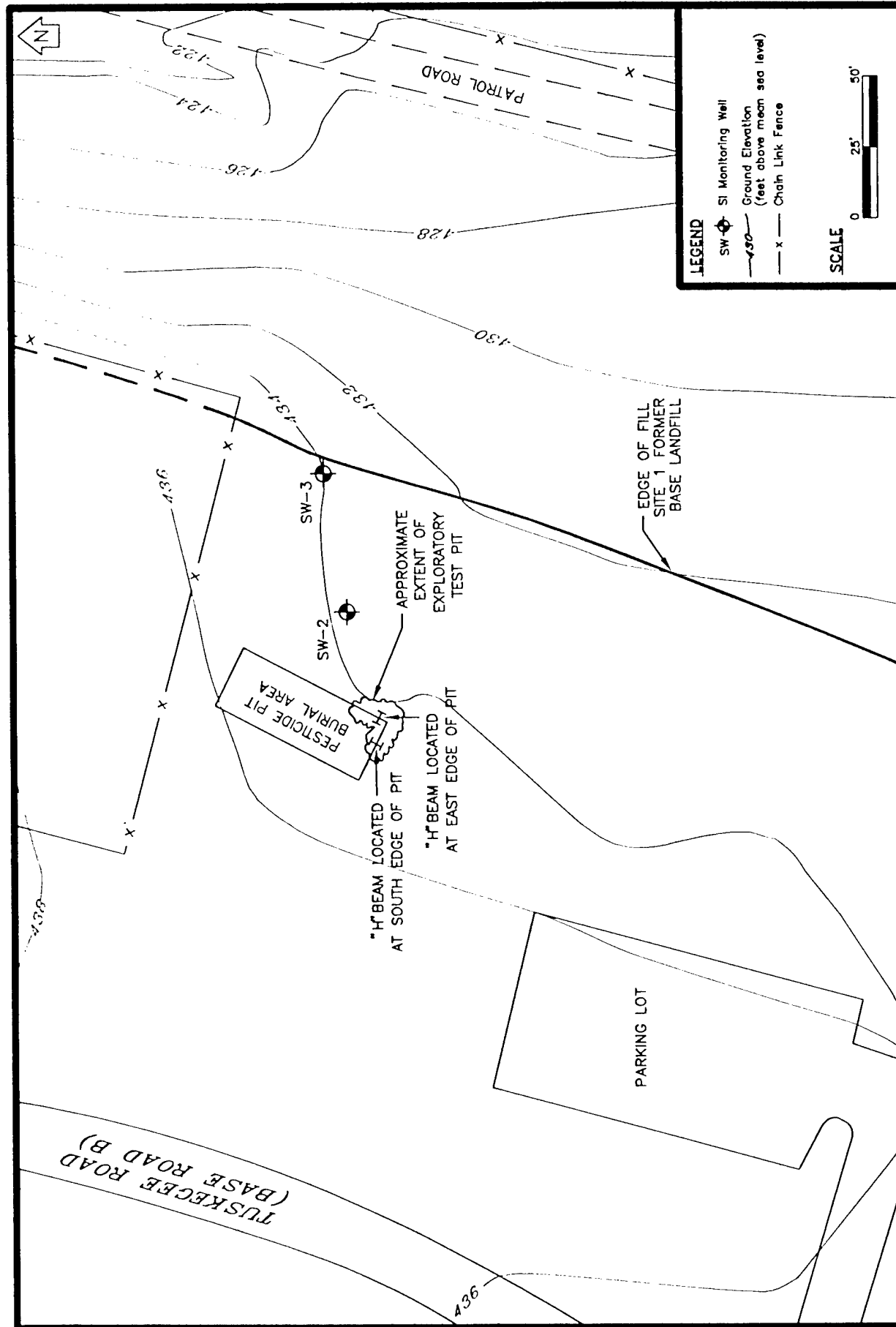
An exploratory test pit was excavated with a Caterpillar E-708 track-mounted backhoe, in order to confirm the actual location of the former burial pit after the geophysical surveys. Soils removed from the pit were placed on the ground surface away from the pit. All observations were recorded in the field log book. Stockpiled soils were placed back into the pit and compacted with the backhoe after the excavation was completed. Figure 5-2 illustrates the location of the exploratory pit.

5.4.2 Soil Borings

Soil borings were advanced during the RI to collect subsurface soil samples, define site geology, and to install the groundwater monitoring wells. Soil borings were advanced using a CME-75 track-mounted drill rig by two methods: (1) hollow-stem augering, and (2) drilling and core barrel sampling followed by advancing steel casing. Soil boring locations are presented in Figure 5-3. Table 5-2 lists the samples submitted for laboratory analysis. All soil borings were performed by East-Coast Thomas Drilling Company.

At each location, soil borings were initially advanced using 8.25-inch outside diameter (OD) hollow stem augers in accordance with Standard Operating Procedure No.2 in Appendix C of the Work Plan (Aneptek, 1995), until split-spoon refusal occurred and the hollow stem auger could no longer be advanced. Drilling and soil sample collection were performed with a 5-foot long diamond-bit NX-type core barrel sampler in accordance with American Society of Testing and Materials (ASTM) Method D2113. The core barrel was advanced 5 feet during each coring run. This method was also used to collect bedrock cores in those borings that were advanced into bedrock. After an interval of soil was cored, steel casing were advanced into the borehole to case off the soils.

After retrieving each sample, the soil to be analyzed for VOCs was first placed in the appropriate containers. PID screening was also performed at this time (see Section 5.3.2.1). Next, the soil for the pesticide screening was collected (see Section 5.3.2.2). Finally, the sample volume



STEWART AIR NATIONAL GUARD BASE

EXPLORATORY TEST PIT LOCATION

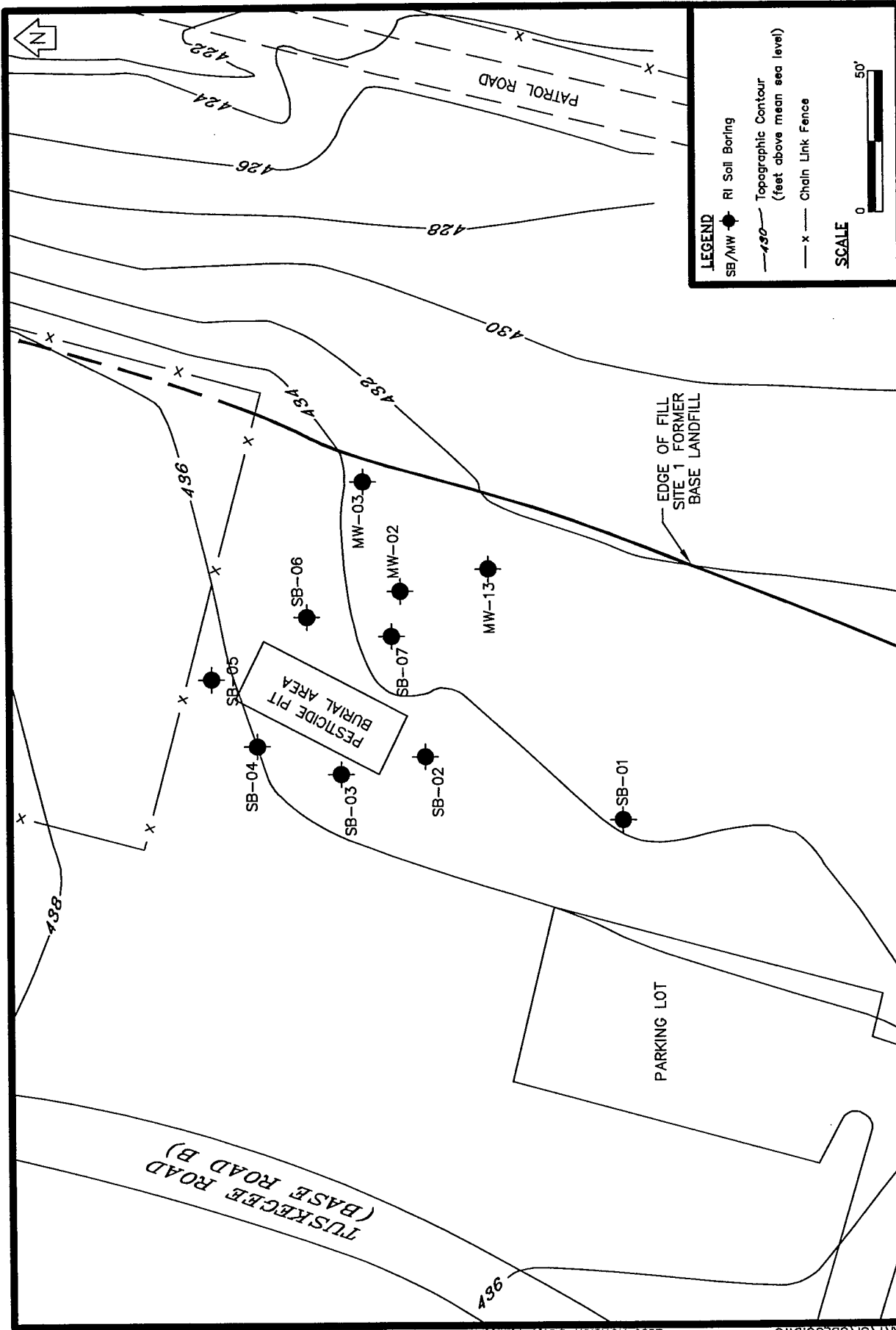
NEWBURGH, NEW YORK

ANEPTEK
CORPORATION
Analytic, Environmental
and Process Technologies

FIGURE: 5-2

LEGEND
SW-1 Monitoring Well
Ground Elevation
(feet above mean sea level)
Chain Link Fence

SCALE
0 25' 50'



required for the remaining analytical parameters was placed in a stainless steel bowl, homogenized and placed in the appropriate sample containers. Soils samples were collected every five feet during soil boring advancement. When using the core-barrel sampler which could produce a five-foot long sample, soil samples were collected from the portion of the recovered material that corresponded to the next five-foot depth interval.

Those borings not completed as wells were abandoned in accordance with Section 5.2.5.1 of the Work Plan (Aneptek, 1995) by tremie grouting the borehole to the ground surface with a standard cement/bentonite mixture, mixed in accordance with NYSDEC requirements. The method was modified slightly for those boreholes advanced into bedrock to include placing #00-Morie sand within the portion of the boring which penetrated the weathered fractured shale prior to grouting the borehole. This change was made to prevent localized changes in groundwater pH induced by the bentonite grout within the weathered fractured shale, because monitoring wells were planned less than 50 feet downgradient of these soil boring locations.

5.4.3 Surface Soil Sampling

Surface soil sampling was performed to support the risk assessment. In accordance with the Work Plan, the first sample collected (from the 0- to 2-foot depth interval) within each soil boring was considered a surface soil sample. These samples were collected using the split spoon samplers described in Section 5.4.2. All samples were submitted for off-site laboratory analysis for the parameters listed in Table 5-2.

5.4.4 Sediment Sampling

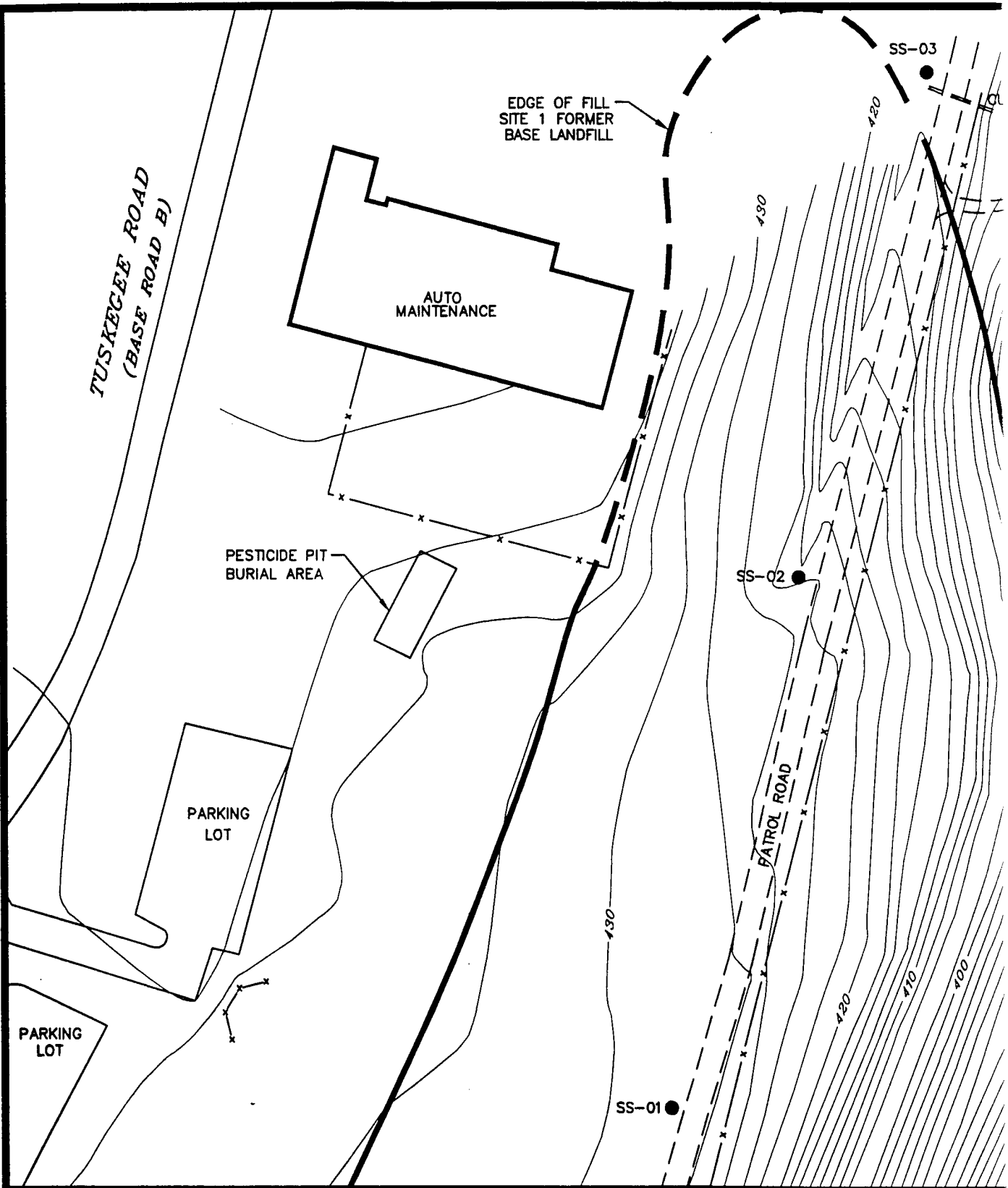
Sediment samples were collected to determine the potential for contaminant migration from the site via sediment transport. Samples were collected in accordance with Aneptek Standard Operating Procedure No. 10, in Appendix C of the Work Plan (Aneptek, 1995). Figure 5-4 presents the locations from which sediment samples were collected. Table 5-1 presents the rationale for the location of the samples. All samples were submitted for off-site laboratory analysis for the parameters listed in Table 5-2.

5.4.5 Monitoring Well Installation, Development and Sampling

Monitoring wells were installed for the collection of groundwater samples, definition of groundwater flow characteristics, and the determination of aquifer properties. Monitoring wells were installed in boreholes drilled as described in Section 5.4.2. All wells were constructed of 2-inch ID Schedule 40 PVC with 0.10-slot wire-wrap screen covered with a filter sock. Well construction details are provided in Appendix E. Figure 5-5 presents the locations of each monitoring well. Monitoring wells MW-01 and MW-09 were screened in shallow bedrock. MW-10 and MW-13 were screened within the overburden. MW-10 was screened across the water table.

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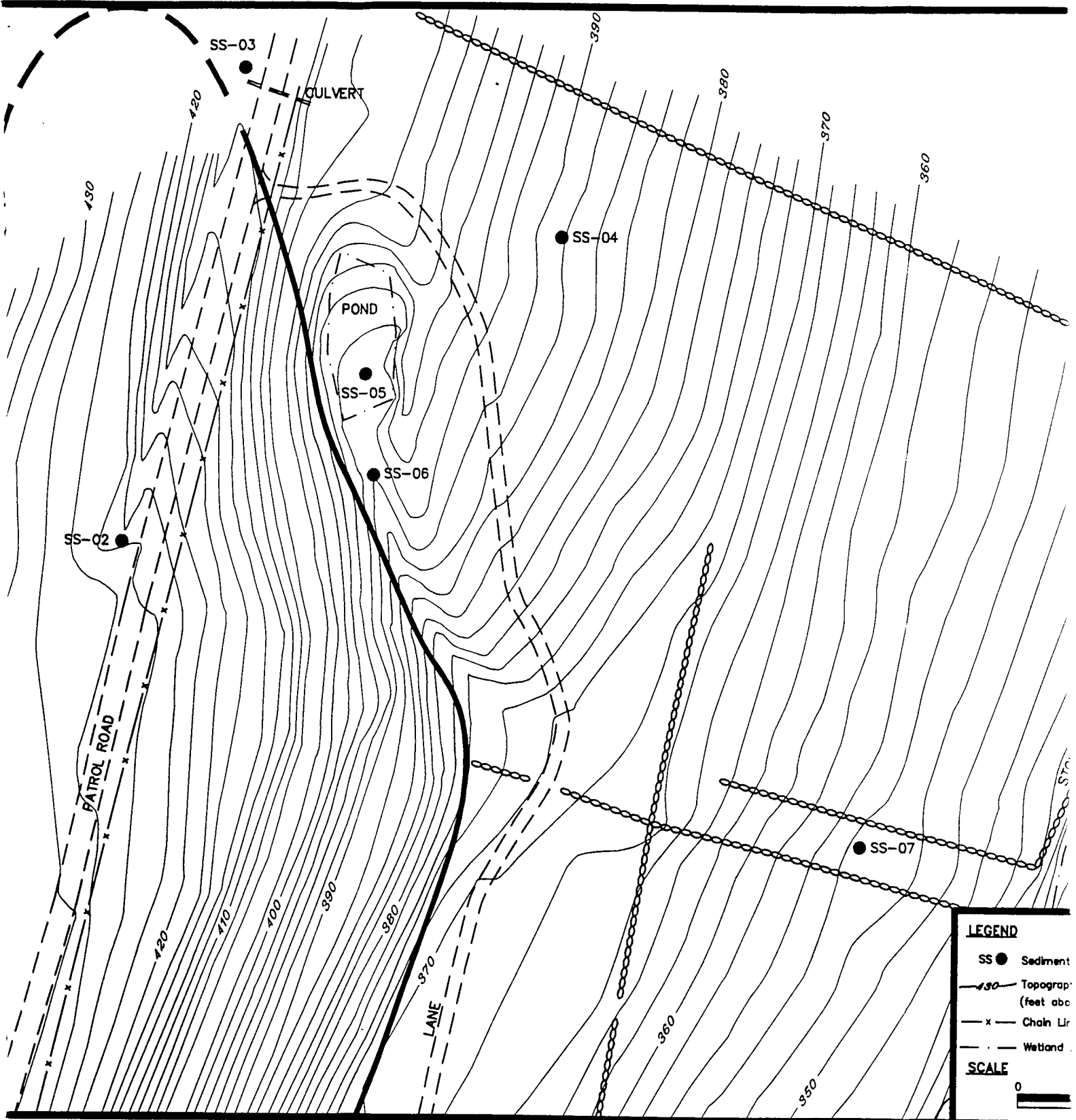


STEWART AIR NATION

SEDIMENT SAMPLE

NEWBURGH, NY

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STEWART AIR NATIONAL GUARD BASE

SEDIMENT SAMPLE LOCATIONS

NEWBURGH, NEW YORK



FIGURE:

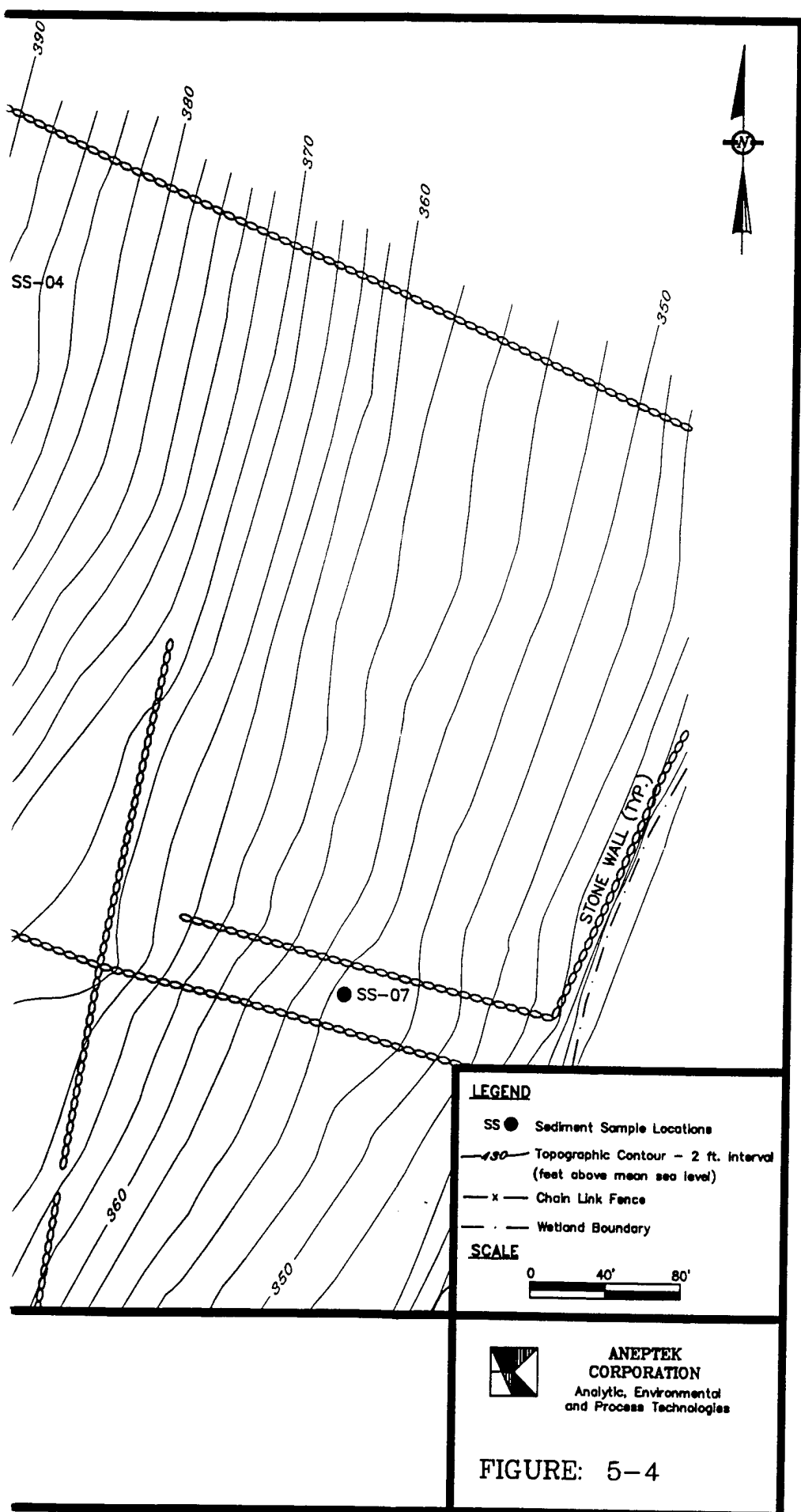
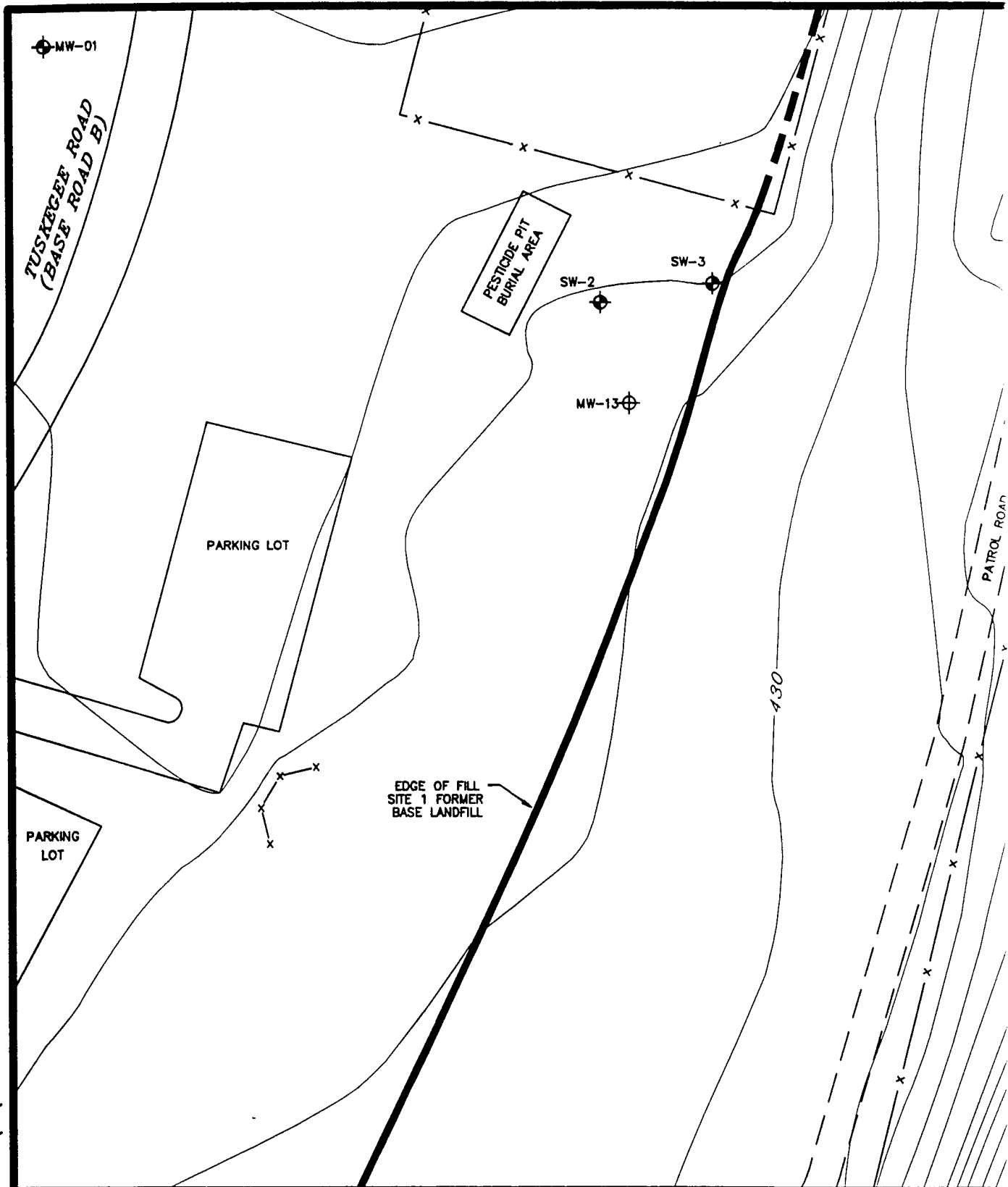


FIGURE: 5-4

Last Revision Date: 3/20/97

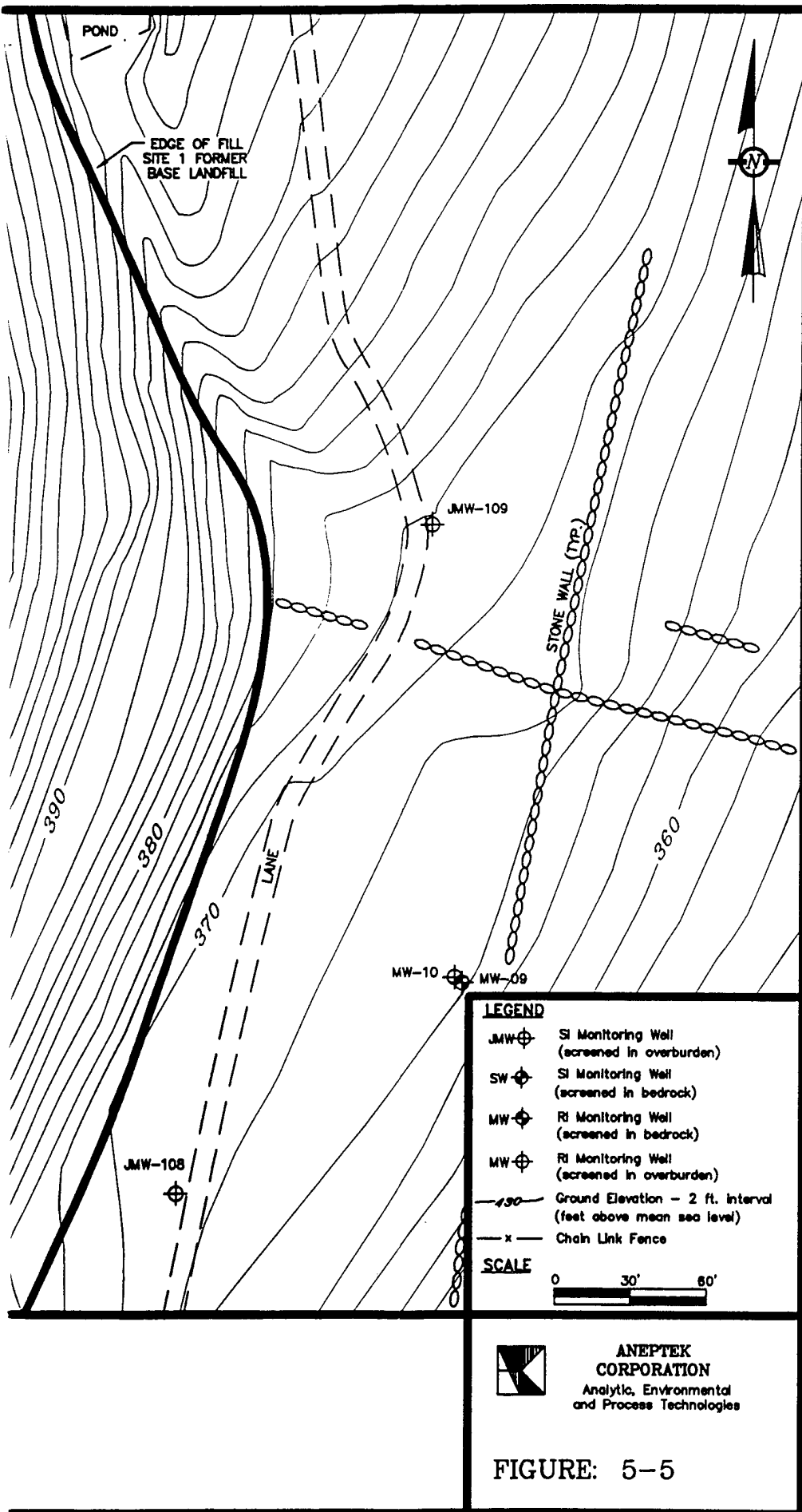
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STEWART AIR NATIONAL GUARD

MONITORING WELL

NEWBURGH, NY



All wells were developed by surging with a surge block, followed by pumping with a check-valve lift pump, in accordance with Aneptek Standard Operating Procedure No. 4 in Appendix C of the Work Plan.

Monitoring wells were sampled with bailers, in accordance with Standard Operating Procedure No. 5 in Appendix C of the Work Plan (Aneptek, 1995). Groundwater samples were collected from the four newly installed monitoring wells as well as from four existing monitoring wells during two rounds of sampling, the first during December, 1995 and the second during March, 1996. All samples were submitted for off-site laboratory analysis for the parameters listed in Table 5-2.

5.4.6 In-situ Aquifer Testing

In-situ (slug) tests were performed on all wells installed for this investigation, to provide an estimate of aquifer hydraulic conductivity. The basic test procedure is described in several papers in the technical literature, including Bouwer and Rice (1976) as well as Standard Operating Procedure No. 11 in Appendix C of the Work Plan (Aneptek, 1995). Details of the testing procedure are provided in Appendix G.

The test data were recorded with a In-Situ® Hermit 2000 digital data logger connected to a pressure transducer via a cable. After the test was completed, the data were downloaded from the data logger to a computer for storage and analyzed in the office by the Bouwer and Rice slug test analytical procedure (Bouwer, 1989). See Section 6.1.2.4 for a detailed discussion of analytical methods and results. All slug test data and analyses are provided in Appendix G.

5.5 Investigation Derived Waste

Investigation derived waste (IDW) generated during RI included drill cuttings generated during the advancement of soil borings and water evacuated from each monitoring well during development and purging. As IDW was generated, it was placed in U.S. Department of Transportation (DOT)-approved 55-gallon drums. Soil and water were never stored within the same drum. All drums were labeled to identify drum contents, the source of the IDW, and the date the wastes were drummed. On December 6, 1995, all drums containing soils were sampled for chemical analysis by EnviroTest Laboratories in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) as specified in the following guidance:

- Federal Register Vol. 57, No. 227 (11/92); and
- Federal Register Vol. 55, No. 126 (6/90).

The following TCLP Analytical procedures were employed:

- VOCs - TCLP 8240
- SVOCs - TCLP 8270
- Pesticides - TCLP 8080

- Herbicides - TCLP 8150
- Metals - TCLP 6010 (arsenic, barium, cadmium, chromium, lead, selenium, silver), 7470 (mercury), 160.3 (percent solids), 9045 (pH), and 1311 (TCLP extraction).

Results of the TCLP testing are presented in Appendix C. A summary of the TCLP analytical results are presented in Table 5-3. On July 30 and 31, 1996, all IDW was spread on the ground surface after receiving prior approval from NYSDEC.

5.6 Habitat Survey

As specified in Section 5.2.7 of the Work Plan (Aneptek, 1995) a Step I and II Fish and Wildlife Impact Analysis was conducted at Site 2, in accordance with NYSDEC requirements (NYSDEC 1994) by a qualified field biologist. The Step I Analysis included a wildlife habitat assessment and identification of indicator species of flora and fauna. The field data were then integrated into the development of a Step I database which, together with the EPA Level IV analytical database, were used to support performance of the Step II evaluation (the Contaminant-Specific Impact Analysis) that is included in the Baseline Risk Assessment (Section 8.0).

5.7 Surveying

Soil borings and monitoring wells were surveyed by a New York Registered Land Surveyor. Accuracy of the survey was within 0.01 feet for vertical measurements; 0.1 feet for horizontal measurements. The survey was performed by Grevas & Hildreth, P.C. Land Surveyors.

TABLE 5-3
SITE 2 IDW TCLP SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE (mg/L)	REGULATORY LIMIT ¹	SAMPLE NUMBER			
		IDW - 01- 120695	IDW - 02- 120695	IDW - 03- 120695	IDW - 04- 120695
Arsenic	5.0	0.33 U	0.33 U	0.33 U	0.33 U
Barium	100.0	0.37	0.39	0.34	0.2
Benzene	0.5	0.00005 U	0.00005 U	0.00005 U	0.00005 U
Cadmium	1.0	0.03 U	0.03 U	0.03 U	0.03 U
Carbon tetrachloride	0.5	0.00005 U	0.00005 U	0.00005 U	0.00005 U
Chlordane	0.03	0.001 U	0.001 U	0.001 U	0.001 U
Chlorobenzene	6.0	0.01 U	0.01 U	0.01 U	0.01 U
Chloroform	5.0	0.01 U	0.01 U	0.01 U	0.01 U
Chromium	5.0	0.03 U	0.03 U	0.03 U	0.03 U
o-Cresol	² 200.0	0.01 U	0.01 U	0.01 U	0.01 U
m-Cresol	² 200.0	0.01 U	0.01 U	0.01 U	0.01 U
p-Cresol	² 200.0	0.01 U	0.002 J	0.01 U	0.01 U
2,4-D	10.0	0.0005 U	0.0005 U	0.0005 U	0.0005 U
1,4-Dichlorobenzene	7.5	0.01 U	0.01 U	0.01 U	0.01 U
1,2-Dichloroethane	0.5	0.01 U	0.01 U	0.01 U	0.01 U
1,1-Dichloroethylene	0.7	0.01 U	0.01 U	0.01 U	0.01 U
2,4-Dinitrotoluene	0.13	0.01 U	0.01 U	0.01 U	0.01 U
Endrin	0.02	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Heptachlor (and its epoxide)		0.00005 U	0.00005 U	0.00005 U	0.00005 U
Hexachlorobenzene		0.01 U	0.01 U	0.01 U	0.01 U
Hexachlorobutadiene		0.01 U	0.01 U	0.01 U	0.01 U
Hexachloroethane	3.0	0.01 U	0.01 U	0.01 U	0.01 U
Lead	5.0	0.33 U	0.33 U	0.33 U	0.33 U
Lindane	0.4	0.00005 U	0.00005 U	0.00005 U	0.00005 U
Mercury	0.2	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Methoxychlor	10.0	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Methyl ethyl ketone	200.0	0.01 U	0.01 U	0.01 U	0.01 U
Nitrobenzene	2.0	0.01 U	0.01 U	0.01 U	0.01 U
Pentachlorophenol	100.0	0.05 U	0.05 U	0.05 U	0.05 U
Pyridine	5.0	0.01 U	0.01 U	0.01 U	0.01 U
Selenium	1.0	0.33 U	0.33 U	0.33 U	0.33 U
Silver	5.0	0.03 U	0.03 U	0.03 U	0.03 U
Tetrachloroethylene	0.7	0.01 U	0.01 U	0.01 U	0.01 U
Toxaphene	0.5	0.005 U	0.005 U	0.005 U	0.005 U
Trichloroethylene	0.5	0.01 U	0.01 U	0.01 U	0.01 U
2,4,5-Trichlorophenol	400.0	0.01 U	0.01 U	0.01 U	0.01 U
2,4,6-Trichlorophenol	2.0	0.01 U	0.01 U	0.01 U	0.01 U
2,4,5-TP (Silvex)	1.0	0.0005 U	0.0005 U	0.0005 U	0.0005 U
Vinyl chloride	0.2	0.01 U	0.01 U	0.01 U	0.01 U

ABBREVIATIONS

IDW - Investigation Derived Waste
TCLP - Toxicity Characteristic Leaching
Procedure
mg/L - milligrams per liter

DATA QUALIFIERS

J - Estimated Value
U - Below Quantitation Limit

NOTES

¹ Regulatory Limit as Defined
in 40 CFR Part 261.23, Table 1.
² The regulatory level of 200 mg/L is
for total cresol.

SECTION 6.0

6.0 INVESTIGATION FINDINGS

The results of the RI are presented in this section. Section 6.1 provides the study area geologic and hydrologic results and interpretations. Section 6.2 discusses the results of all field and analytical laboratory analyses.

6.1 Site Geologic and Hydrologic Investigation Results

This section discusses the geologic and hydrologic findings of the RI. Data from the associated Landfill Closure Site Investigation (LFCSI) are also included for completeness. Supporting data from previous investigations are found in Appendix A. RI and LFCSI boring logs and monitoring well construction diagrams are provided in Appendix D and E, respectively. Appendix F contains all water level data and associated calculations derived from that data. In-situ permeability test data and analyses are provided in Appendix G.

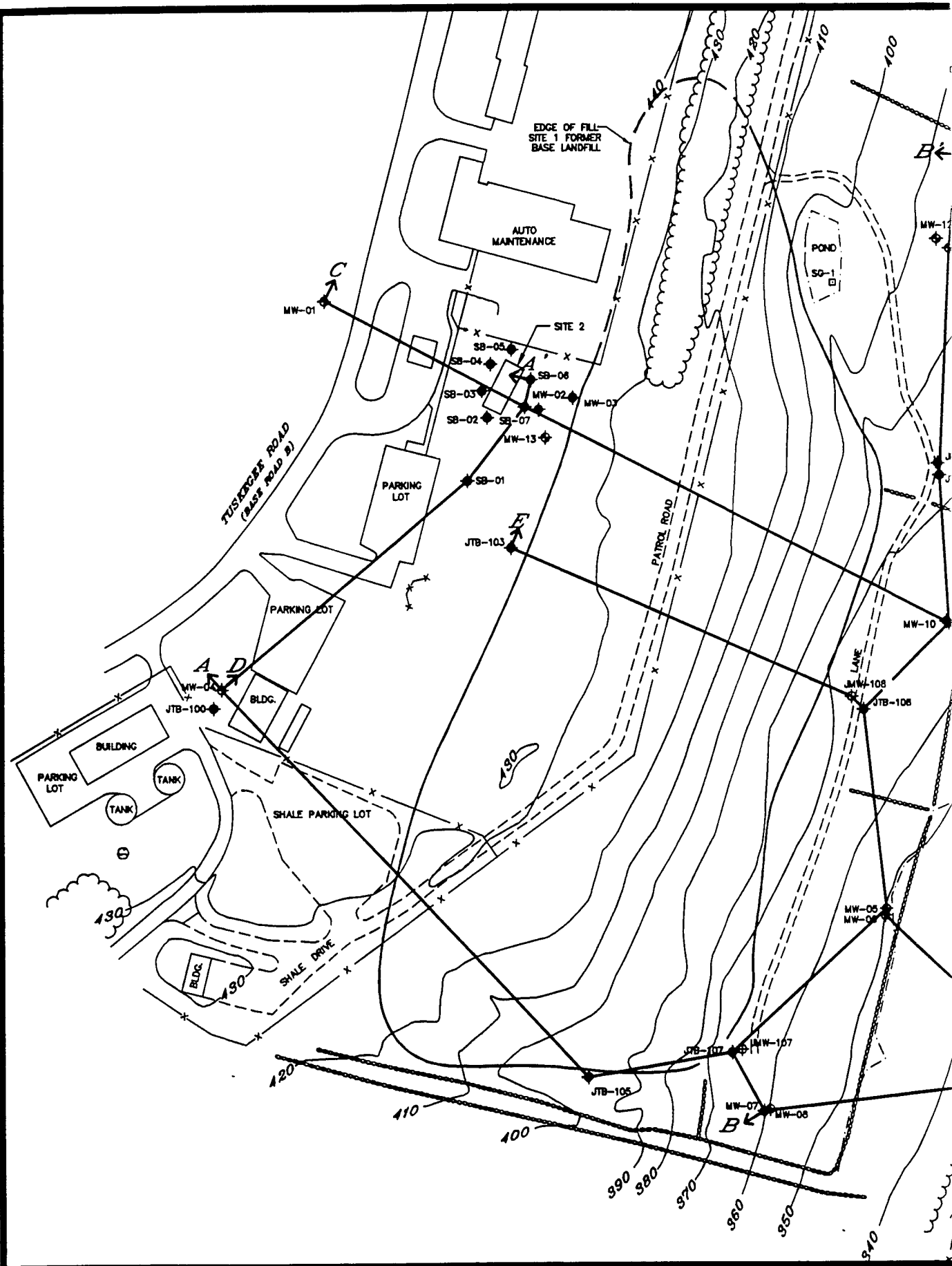
6.1.1 Geology

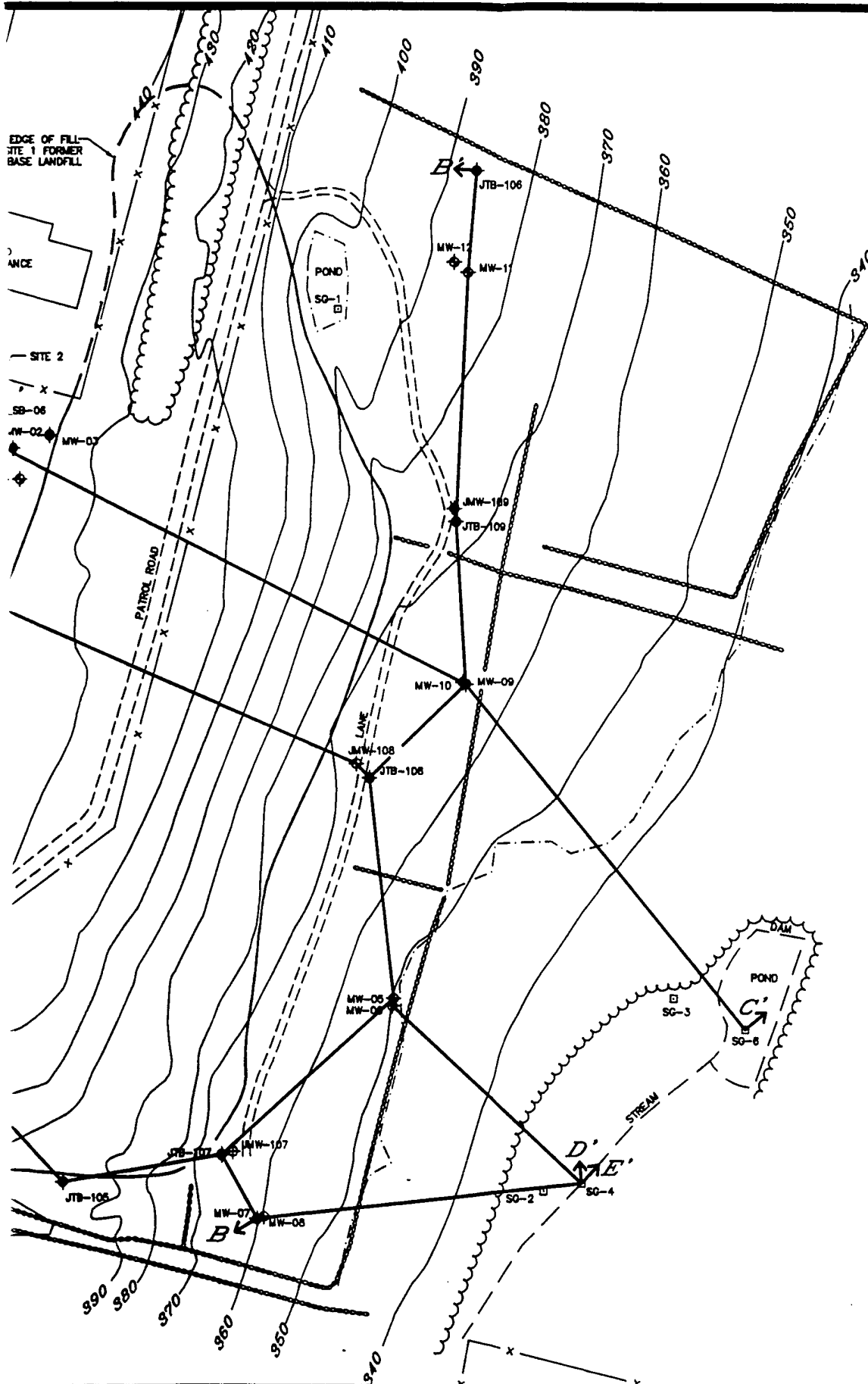
Locations of cross sections that illustrate the geology of the study area are shown on Figure 6-1. Cross sections A-A' through E-E' are provided on Figures 6-2 through 6-6.

6.1.1.1 Surficial Geology

The lithology and character of overburden soil samples observed during the RI are consistent with descriptions from previous investigations (ABB, 1992). The overburden is composed of lodgement glacial till that generally consists of grey, extremely dense CLAY and SILT, some fine to medium, subangular to angular gravel, trace to little sand. Boulders are occasionally encountered at depth. The lodgement till was sufficiently dense to prevent advancement of the borehole by hollow stem auger drilling in the vicinity of Site 2; therefore, borings were advanced by diamond bit coring and samples were collected with a 5-foot NX core barrel after auger refusal. The till has no visible porosity and is so compact that it appears cemented. Samples could be broken apart for detailed examination only with great difficulty. Although they are suspected to be present, fractures in the till are not visible in samples collected for this study.

As shown on Figures 6-2 and 6-4, the thickness of the lodgement till varies from 9 to 34.5 feet in the vicinity of Site 2. The lodgement till becomes thinner and less dense to the east of Site 2, towards the toe of the slope (it was not observed at JTB-107) as shown on Figure 6-3 (a north-south cross section across the toe of the landfill) and Figures 6-4 and 6-5 (east west cross sections across the landfill). Although split spoons could be advanced through the less dense till, it was still considered lodgement till due to high blow counts (>40/ft) required to advance a sampler through the soil. The lodgement till is thought to transition completely to weathered till beneath the wetlands at lower elevations, although no borings were advanced in this area.

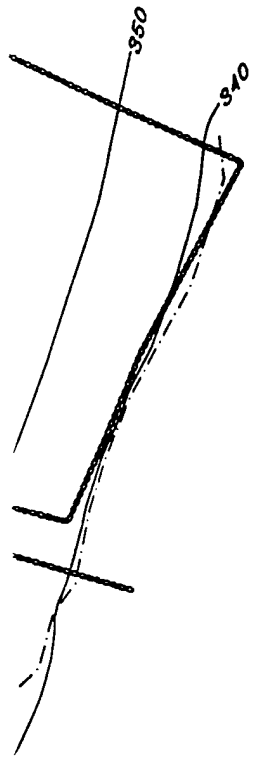




STEWART AIR NATIONAL
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CROSS SECTION LOCATION

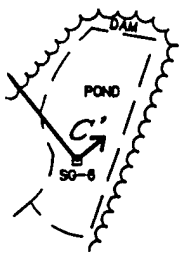
NEWBURGH, NEW YORK



LEGEND

- JTB ◆ SI Piezometer Cluster
- JMW ⊕ SI Monitoring Well
- MW ⊕ Monitoring Well
- SB/MW ◆ Soil Boring
- SG □ Staff Gauge
- 340 — Ground Surface Elevation Contour
- x-x- Chain Link Fence
- Stone Wall
- - - Wetland Boundary
- ~~~~~ Edge of woods
- C — C' Cross Section Location

SCALE



STEWART AIR NATIONAL
GUARD BASE

CROSS SECTION LOCATION MAP

NEWBURGH, NEW YORK



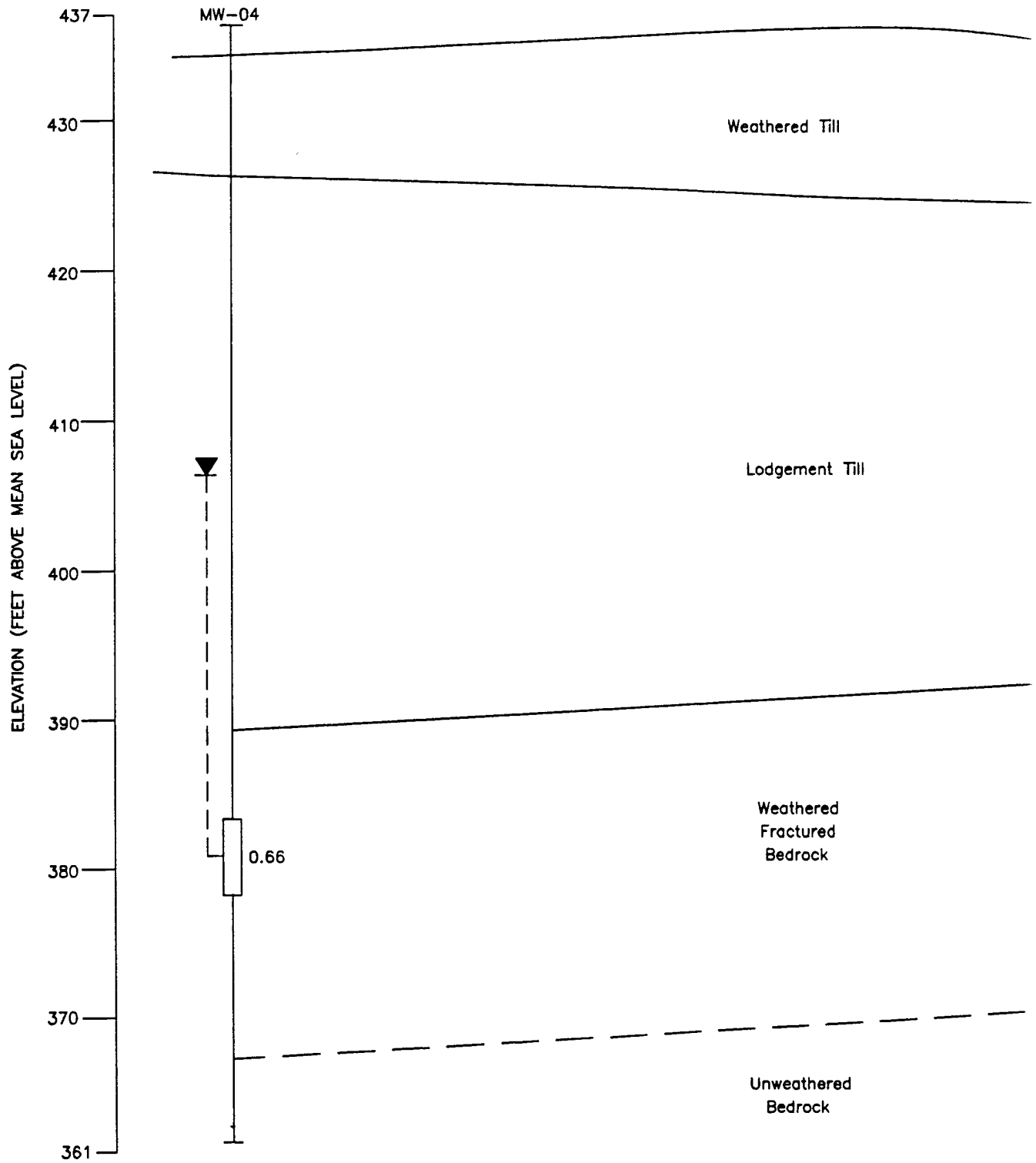
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FIGURE: 6-1

A (west)

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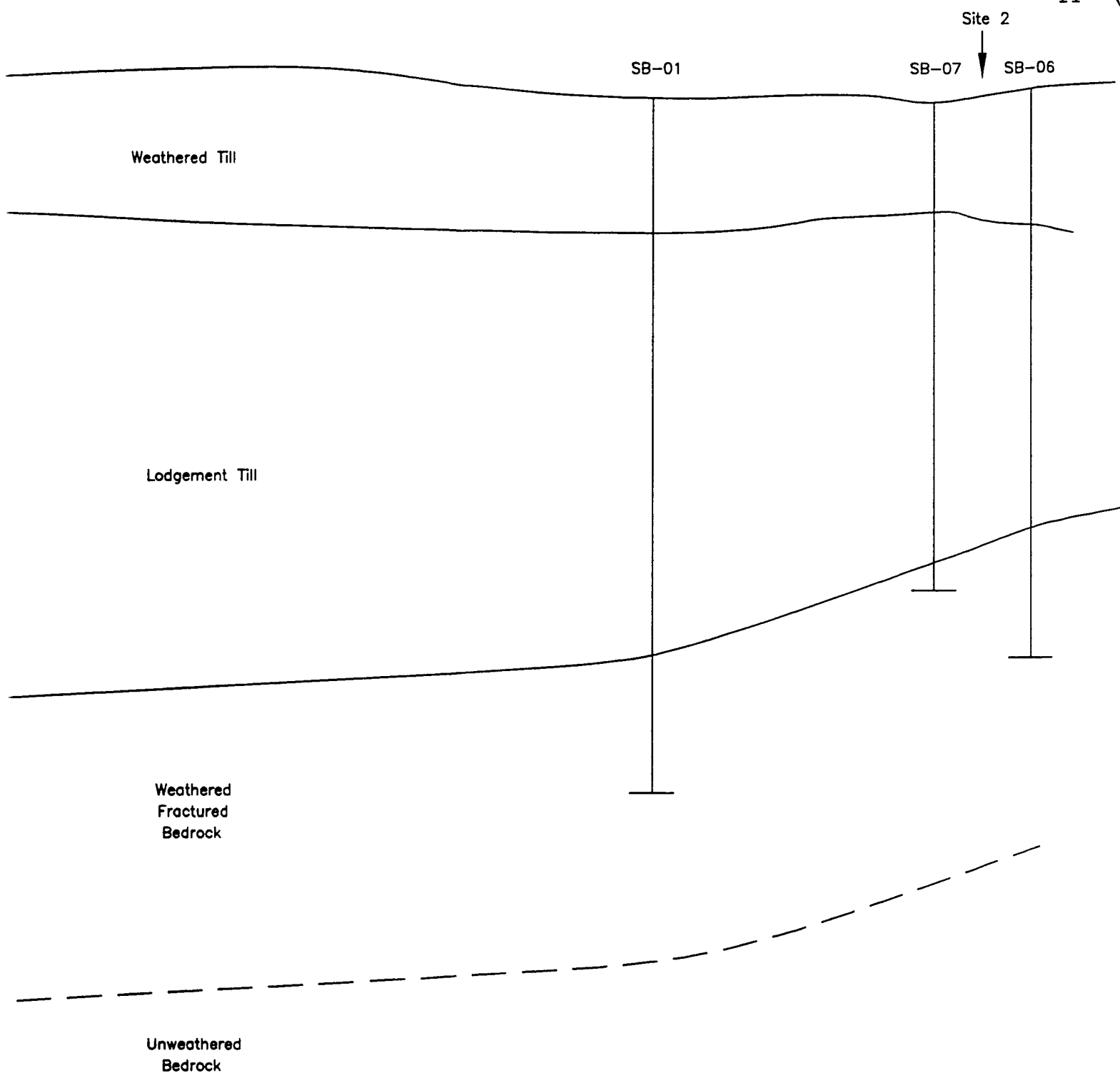


STEWART AIR NATIONA

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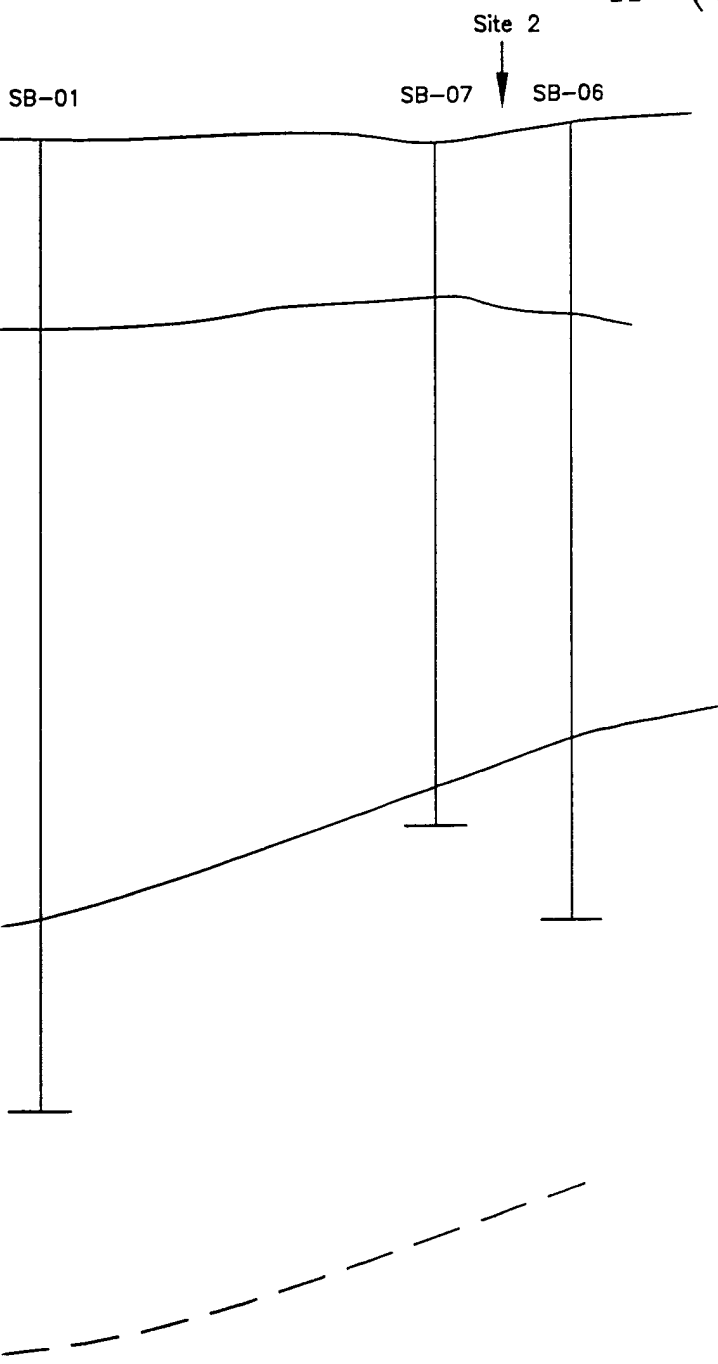


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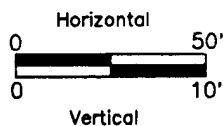
HYDROGEOLOGIC CROSS SECTION A - A'

NEWBURGH, NEW YORK

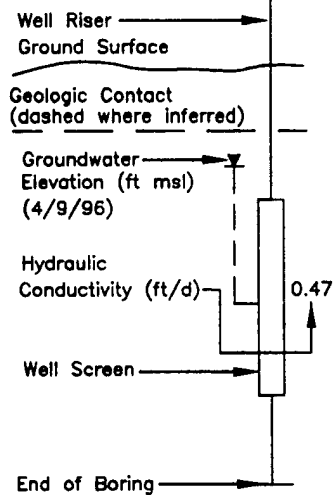
A' (east)



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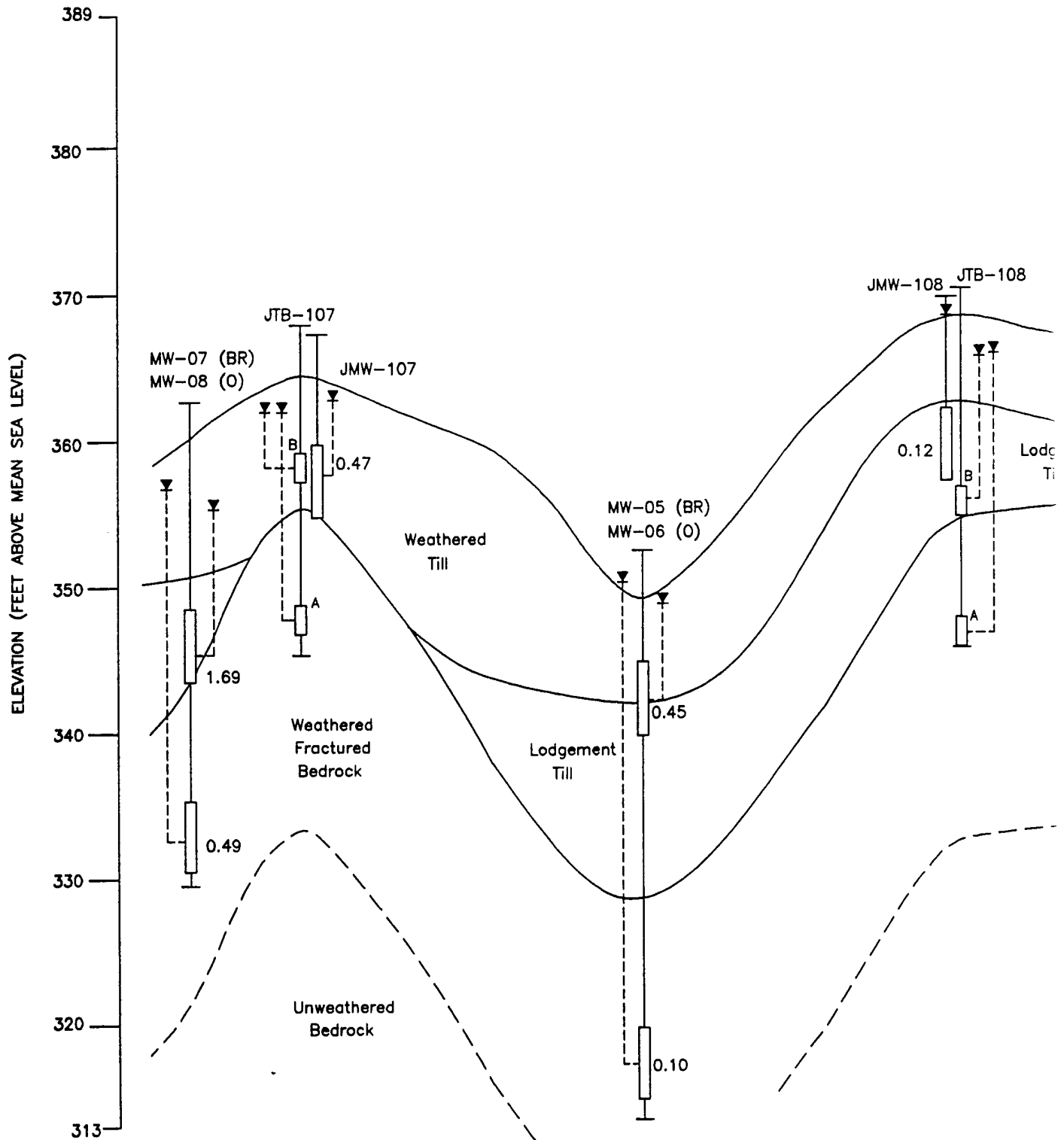
SB Soil Boring
MW Monitoring Well



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FIGURE: 6-2

B (west)



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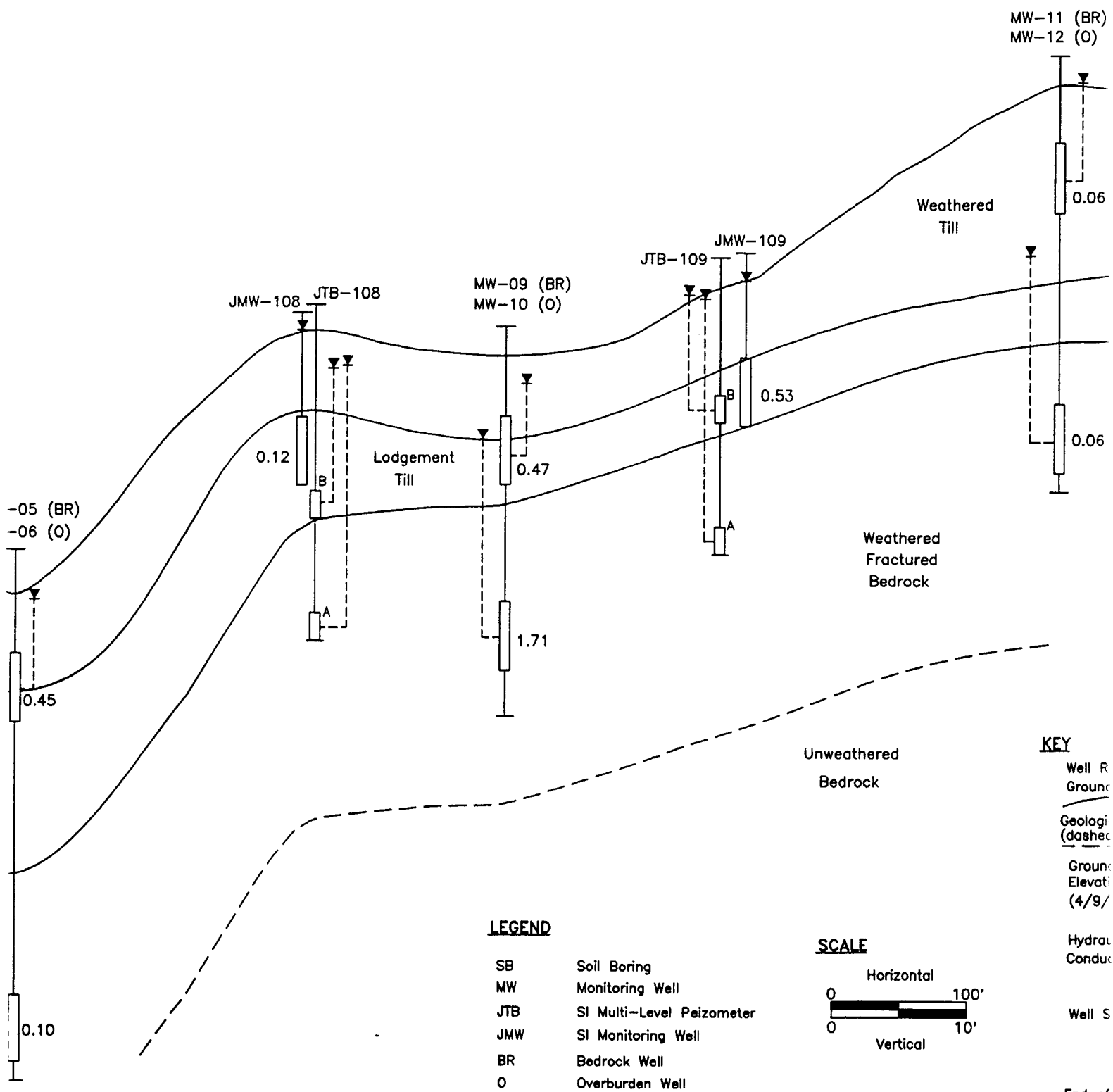
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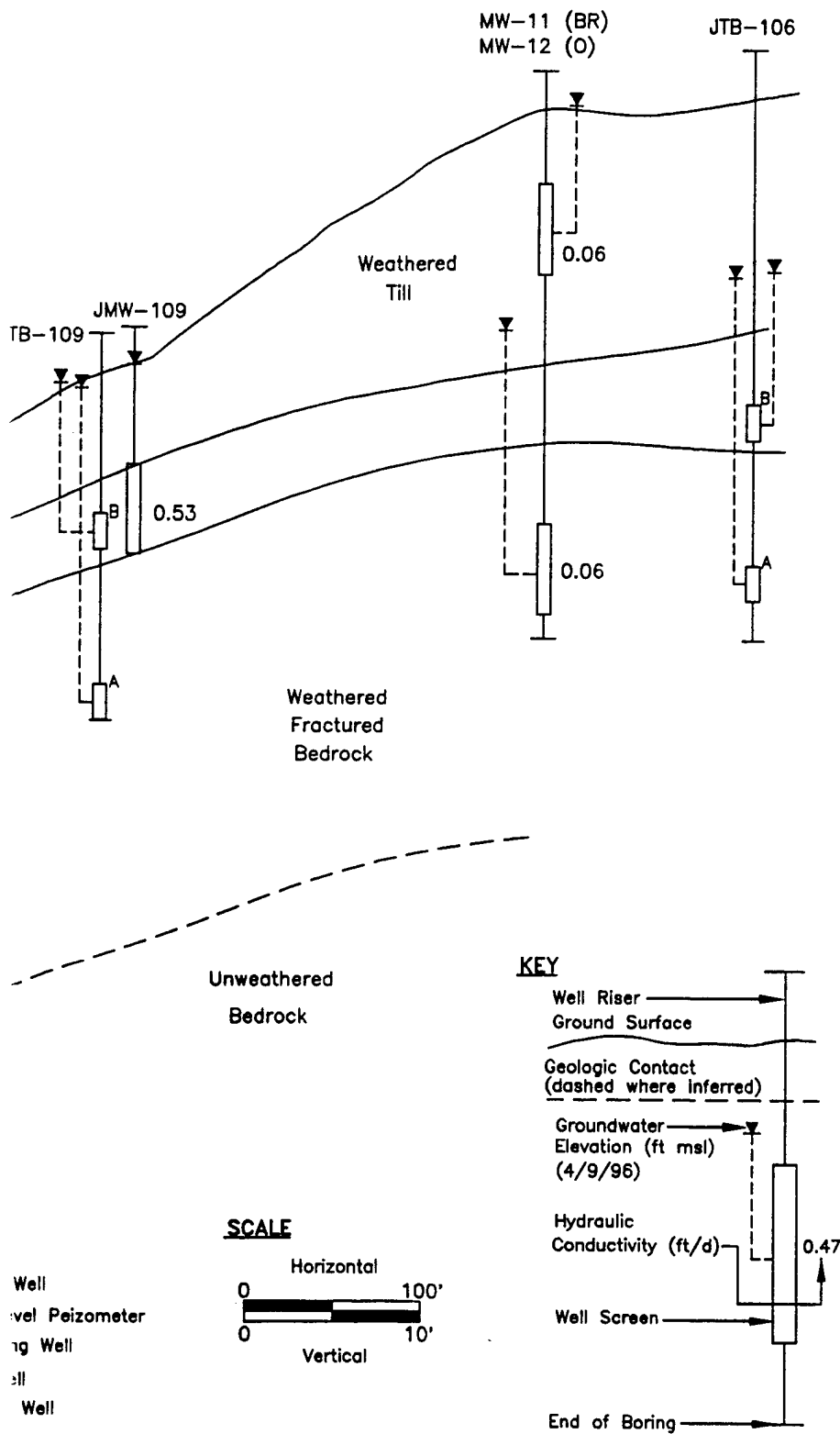


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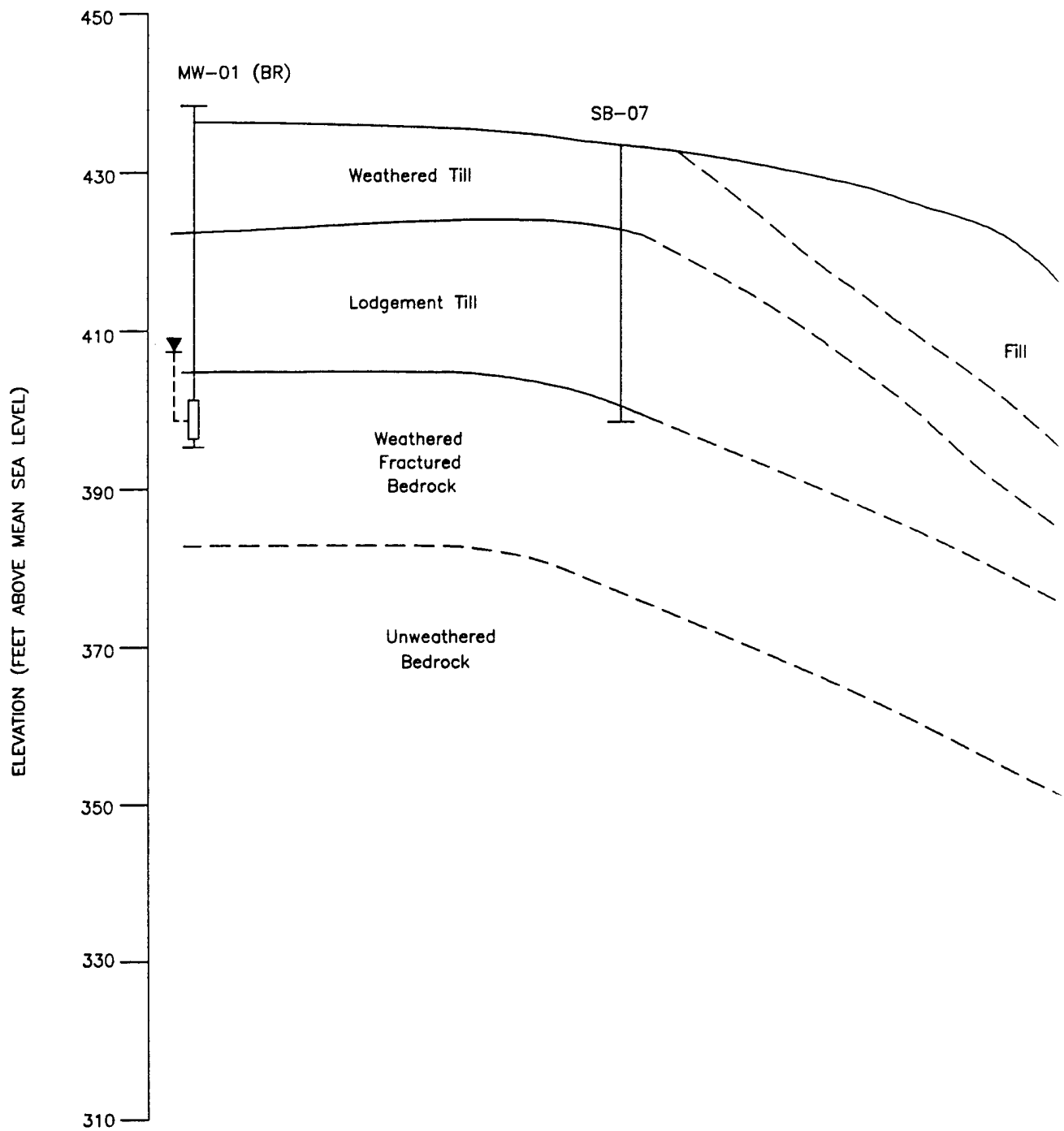
B' (east)



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FIGURE: 6-3

C (west)



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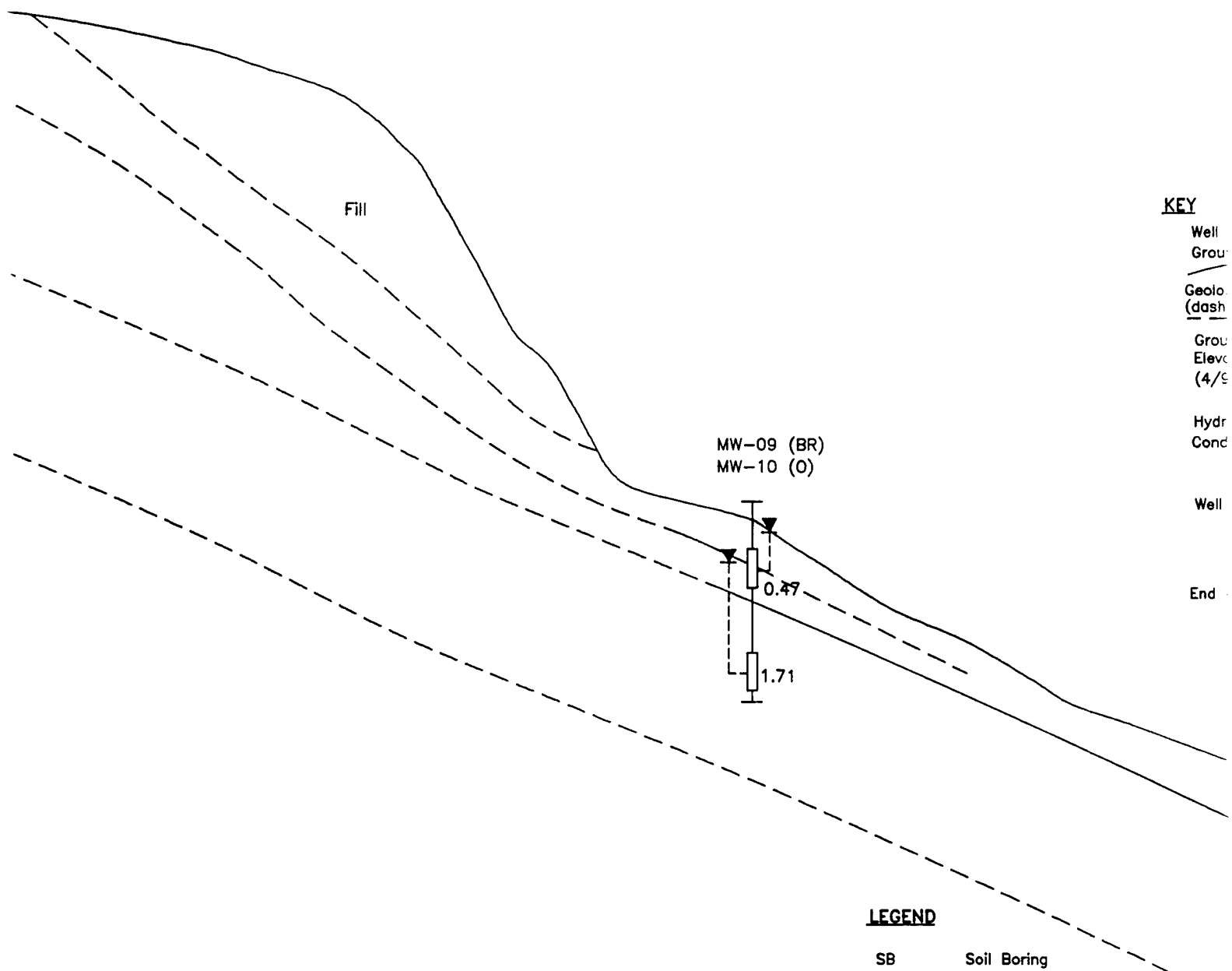
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- LEGEND**
- SB Soil Boring
 - MW Monitoring Well
 - SG Staff Gage
 - BR Bedrock Well
 - O Overburden Well

STEWART AIR NATIONAL GUARD BASE

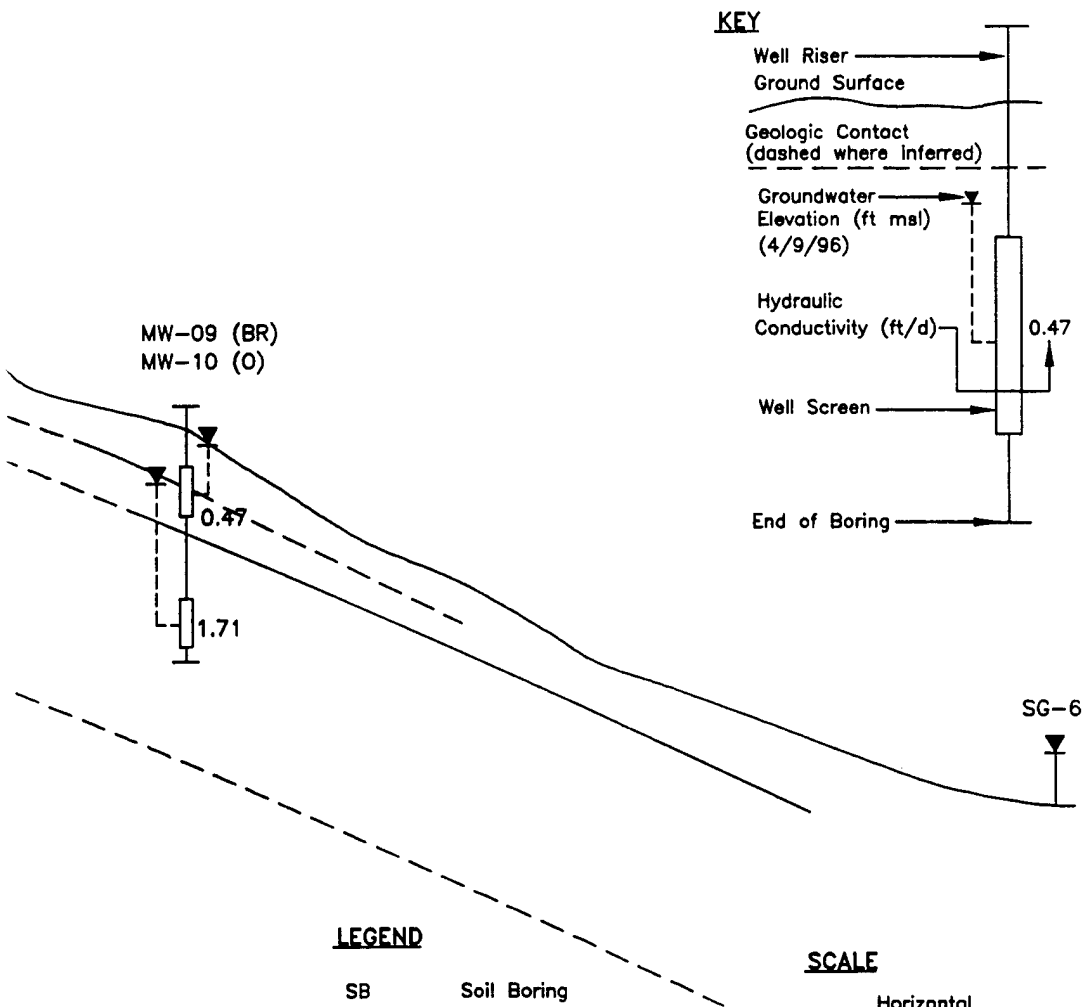
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NEWBURGH, NEW YORK



FIG

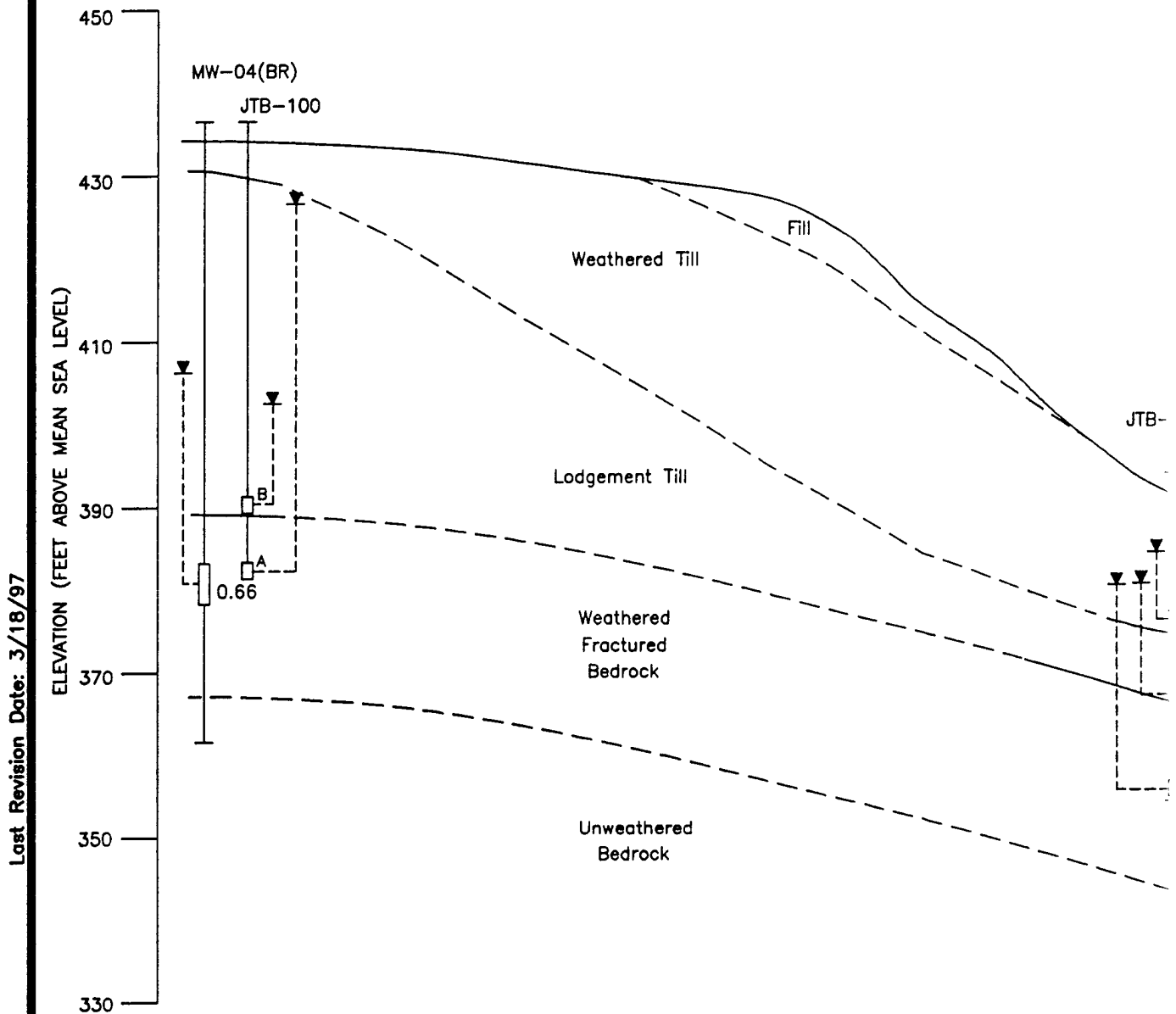
C' (east)



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FIGURE: 6-4

D (west)



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STEWART AIR NATION

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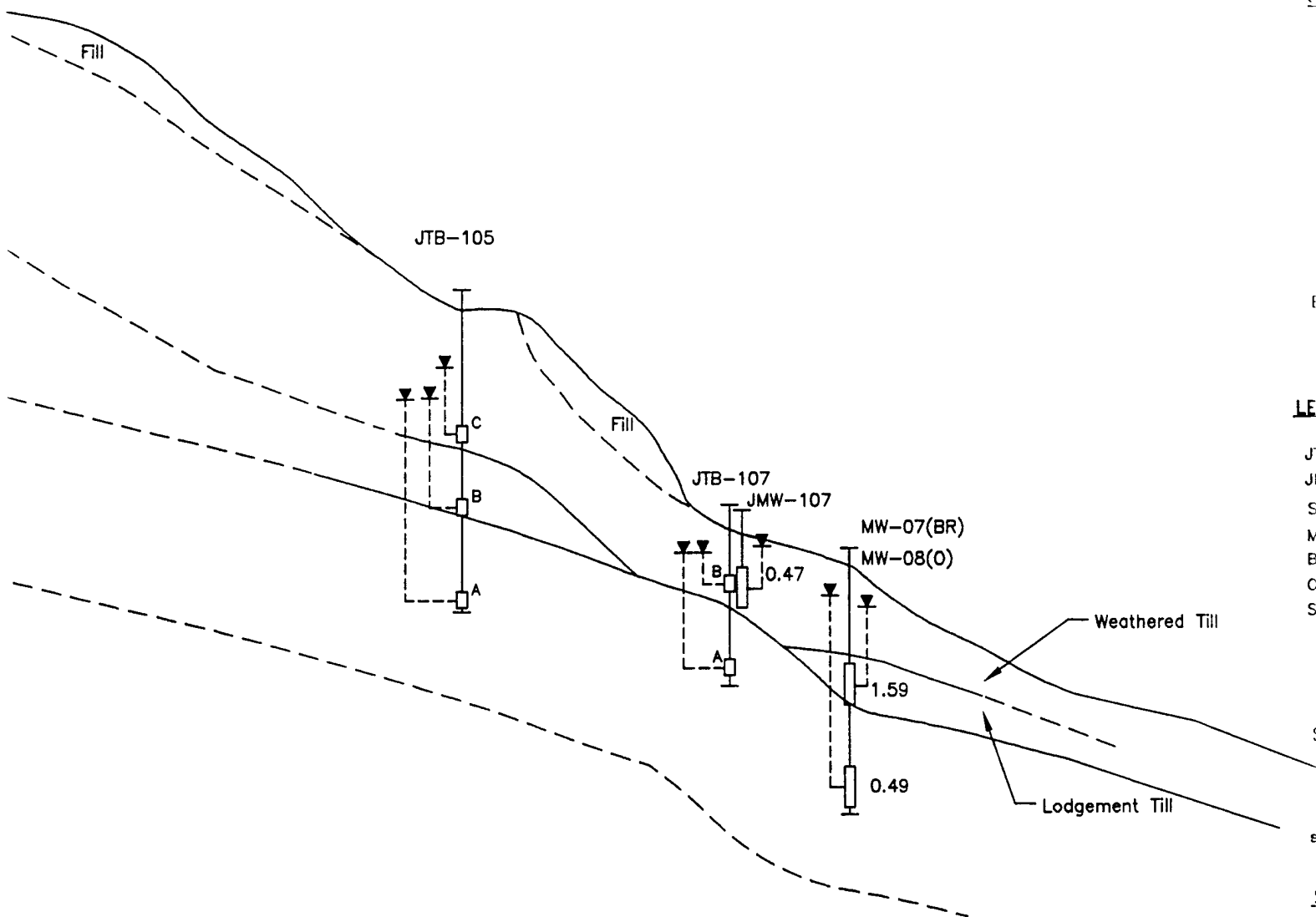
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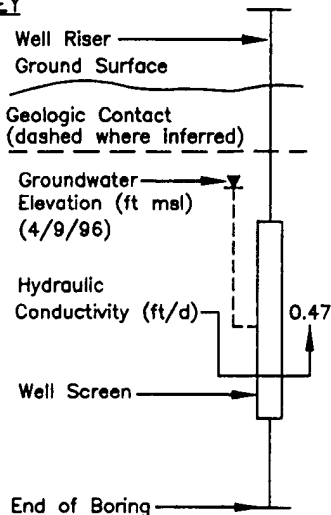
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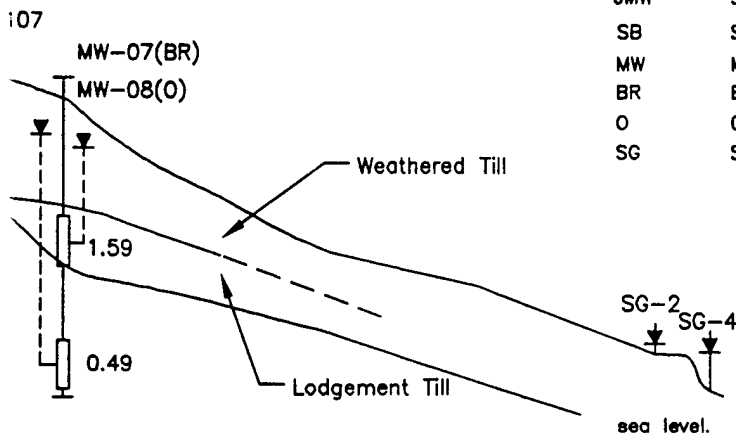
D' (east)

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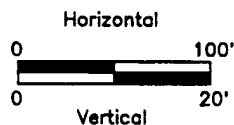


LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
SB	Soil Boring
MW	Monitoring Well
BR	Bedrock Well
O	Overburden Well
SG	Staff Gage



SCALE

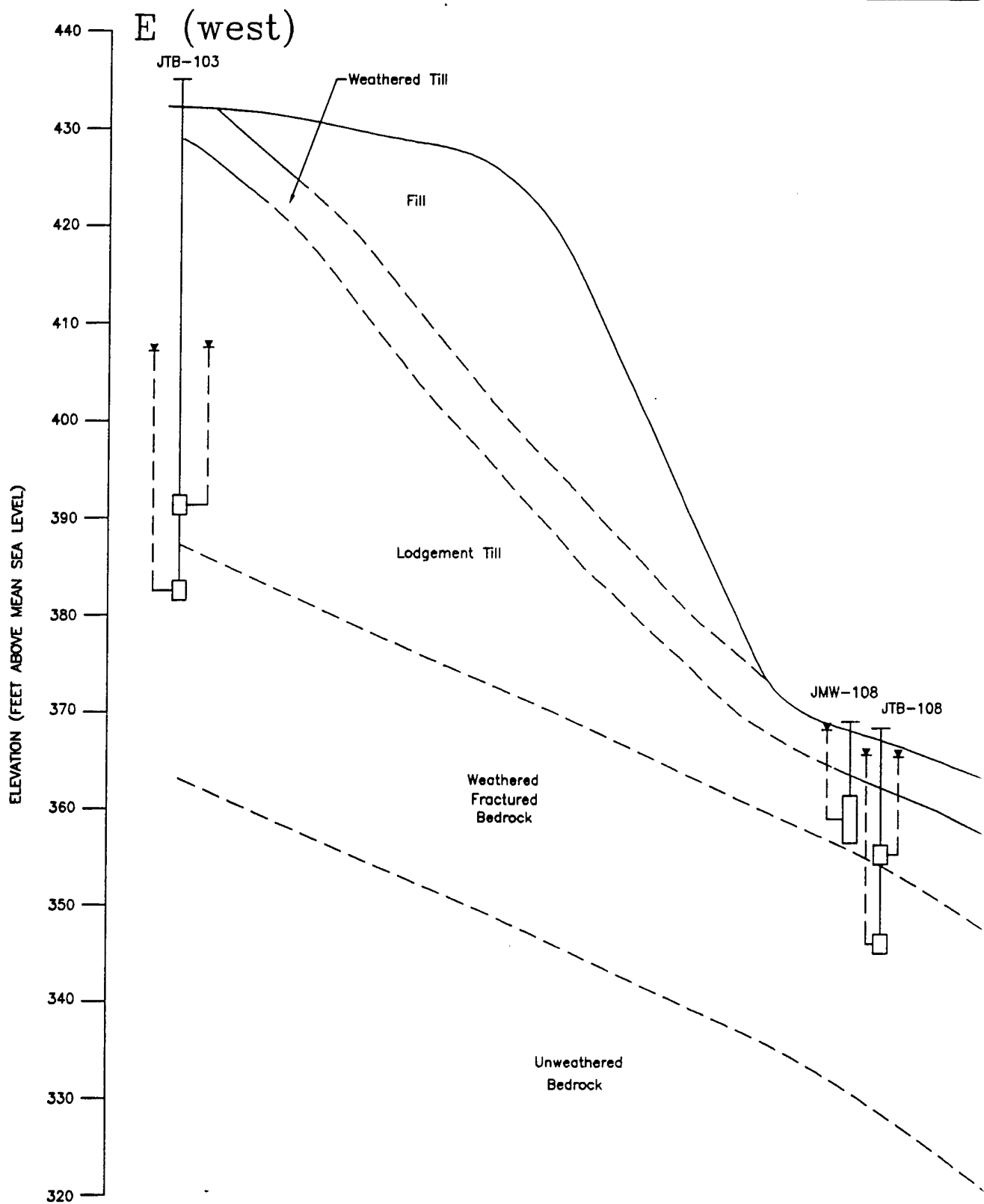


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FIGURE: 6-5

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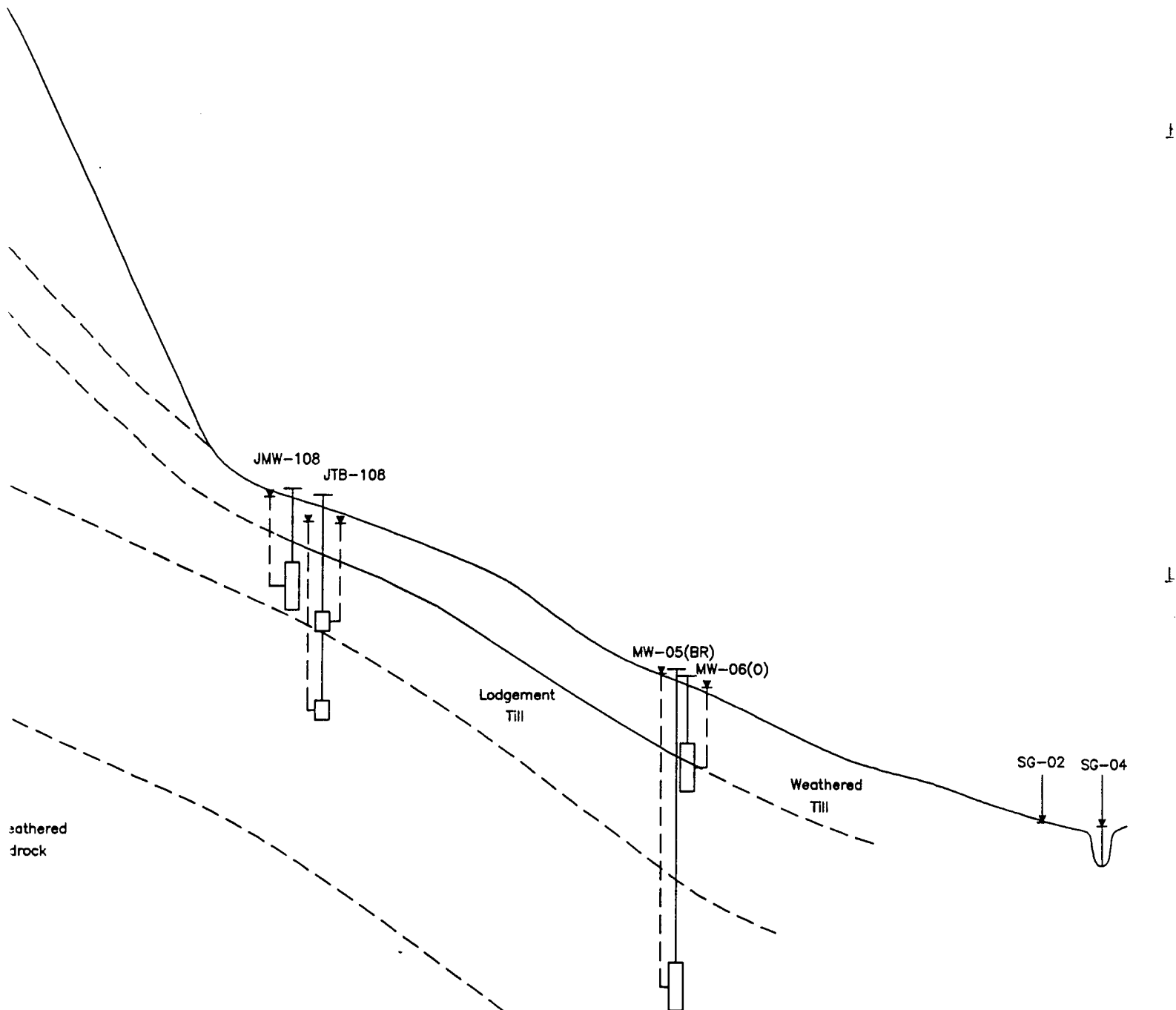
STEWART AIR NATION

HYDROGEOLOGIC CROSS

NEWBURGH, NE

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E' (east)



STEWART AIR NATIONAL GUARD BASE

HYDROGEOLOGIC CROSS SECTION E - E'

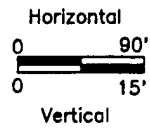
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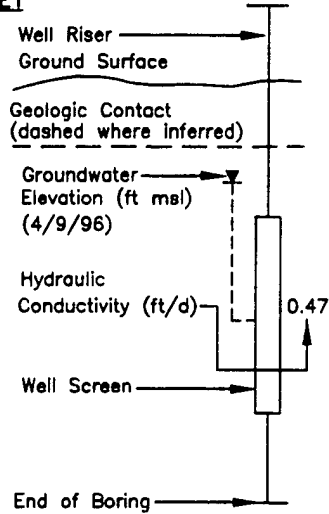
6-7

E' (east)

SCALE

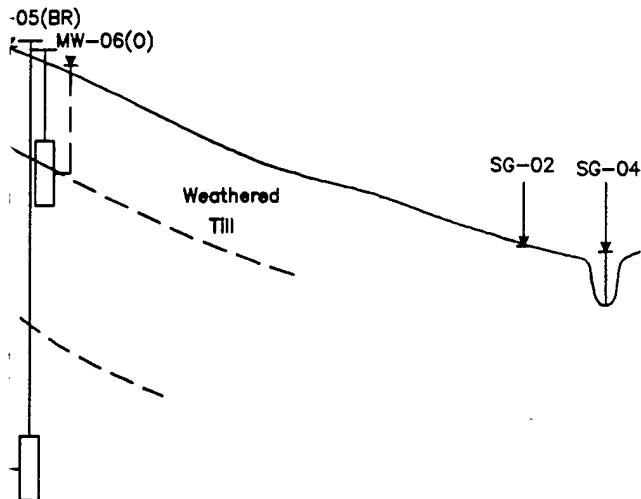


KEY



LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gauge



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and Process Technologies

FIGURE: 6-6

Overlying the lodgement till is an interval of weathered till generally described as brown, medium dense to dense, poorly sorted, well graded CLAY and SILT, some to little fine to medium, subangular to angular gravel, and little to no sand. The weathered till is much less dense than the lodgement till. The boundary between the weathered and unweathered till is observed between 4 to 18 feet bgs. The contact is generally indicated by both the color change, which defines the contact between aerobic and anaerobic soil zones and a sharp increase in blow counts and/or auger/split spoon refusal.

6.1.1.2 Bedrock Geology

The lithology and character of bedrock observed during the RI are consistent with descriptions from previous investigations performed by ABB (ABB, 1989).

Bedrock in the immediate vicinity of Site 2 is encountered at depths of approximately 30 to 43.5 feet bgs (see Figures 6-2 and 6-4). Bedrock in this area is composed of fractured and weathered, soft, dark grey shale. Tight to open planar fractures were generally observed to be parallel to the bedding planes with a dip orientation of approximately 40 to 45 degrees from vertical. At most locations iron staining (goethite) was observed within fractures, indicating the flow of oxygenated groundwater. Occasional subvertical tight to open non-planar joints were also observed in some cores.

MW-04, installed as part of the Landfill Closure Site Investigation (LFC SI), was advanced to 67 feet bgs (28 feet into bedrock) in order to evaluate the extent of the weathered fractured shale zone contributing to groundwater flow. The observed fractures at a depth of 67 feet bgs in MW-04 appeared to be induced by the coring process, based on the close fit of core pieces and the lack of iron staining which indicated a fresh fracture surface.

Based on the MW-04 core, the weathered fractured shale zone is estimated to be approximately 22 feet. This thickness is greater than the maximum thickness of 10 feet initially reported by Dames and Moore (1986) and subsequently reported by E.C. Jordan (1989). Although the thickness of the weathered fractured shale bedrock zone contributing to flow is likely to vary through the study area, for the purposes of this investigation, the 22-foot thickness is assumed to be constant for calculation purposes.

Elevation calculations for the overburden/bedrock contact are provided on Table 6-1 and are shown on Figure 6-7. Figure 6-7 summarizes significant lithologic and structural interpretations from SI and RI core data. Figure 6-7 shows that bedrock slopes to the east, with a maximum elevation of approximately 400 feet msl in the vicinity of Site 2. Also noted on Figure 6-7 are indications of a high degree of fracturing (the retrieved core was basically weathered rubble with a low rock quality designator (RQD)) denoted with an "F", the presence of slickensides ("S") and the presence of calcite veins and lenses ("C") in the rock matrix. Of interest is the distribution of bedrock where significant secondary calcite veins are observed. These cores were primarily found on the eastern side of the study area. Fractures with slickensides and highly fractured cores appear to be confined to this area as well. The change in lithology and structural

TABLE 6-1
TOP OF BEDROCK ELEVATION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

LOCATION	GROUND SURFACE ELEVATION (ft msl)	DEPTH TO BEDROCK (ft bgs)	BEDROCK ELEVATION (ft msl)
MW-01	436.40	31.6	404.80
MW-02	432.90	30.2	402.70
MW-03	433.70	32.0	401.70
MW-04	434.20	45.0	389.20
MW-05	349.90	21.3	328.65
MW-07	360.10	16.4	343.70
MW-09	366.20	10.3	355.87
MW-11	385.90	18.0	367.90
JTB-100	433.90	45.6	388.30
JTB-103	432.60	45.0	387.60
JTB-105	391.80	25.5	366.30
JTB-106	386.80	19.6	367.20
JTB-107	364.70	9.4	355.30
JTB-108	367.40	12.8	354.60
JTB-109	371.60	10.4	361.20
SB-01	433.80	40.0	393.80
SB-06	434.60	31.5	403.10
SB-07	433.40	32.8	400.65

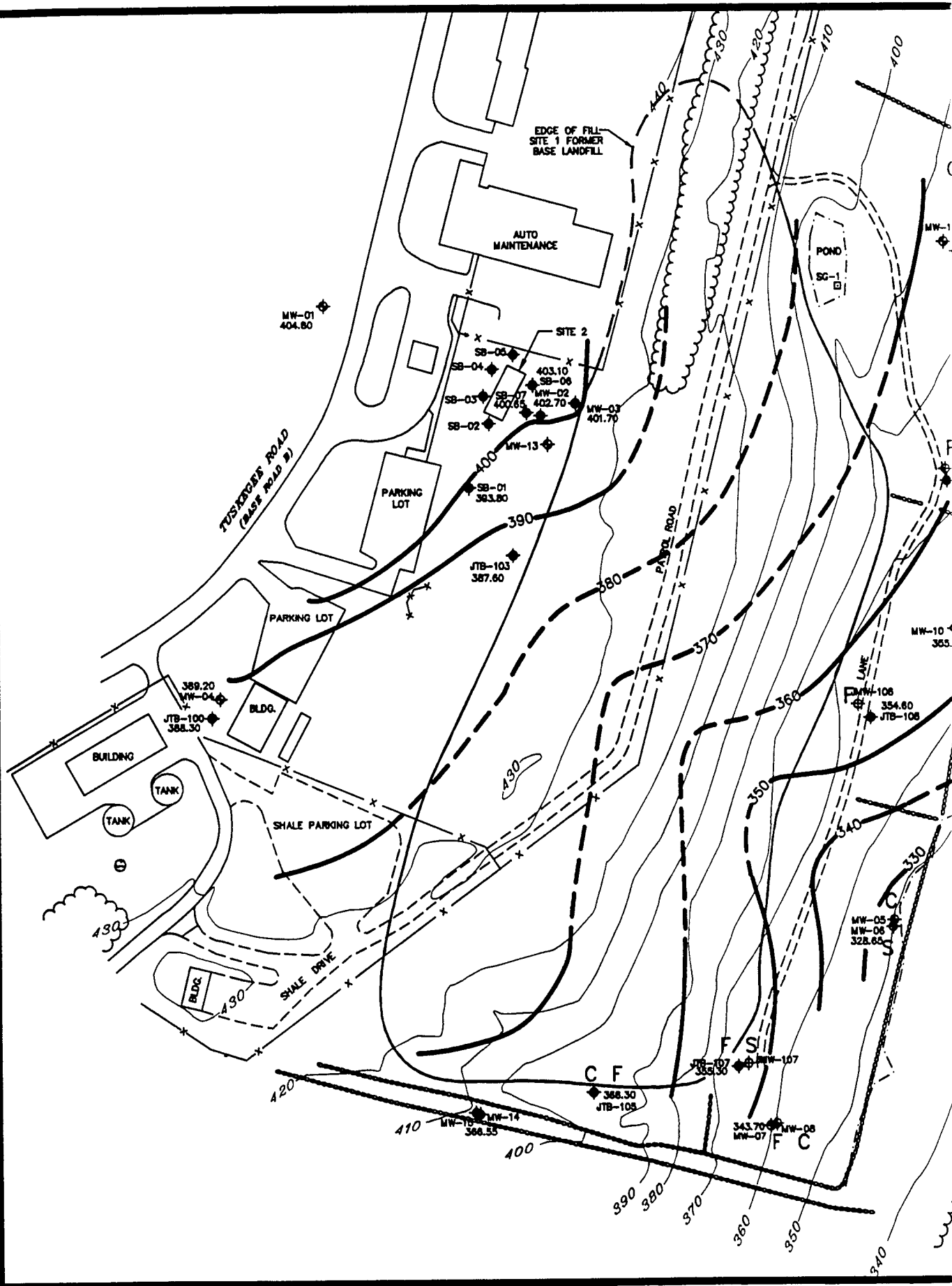
ABBREVIATIONS

ft - feet

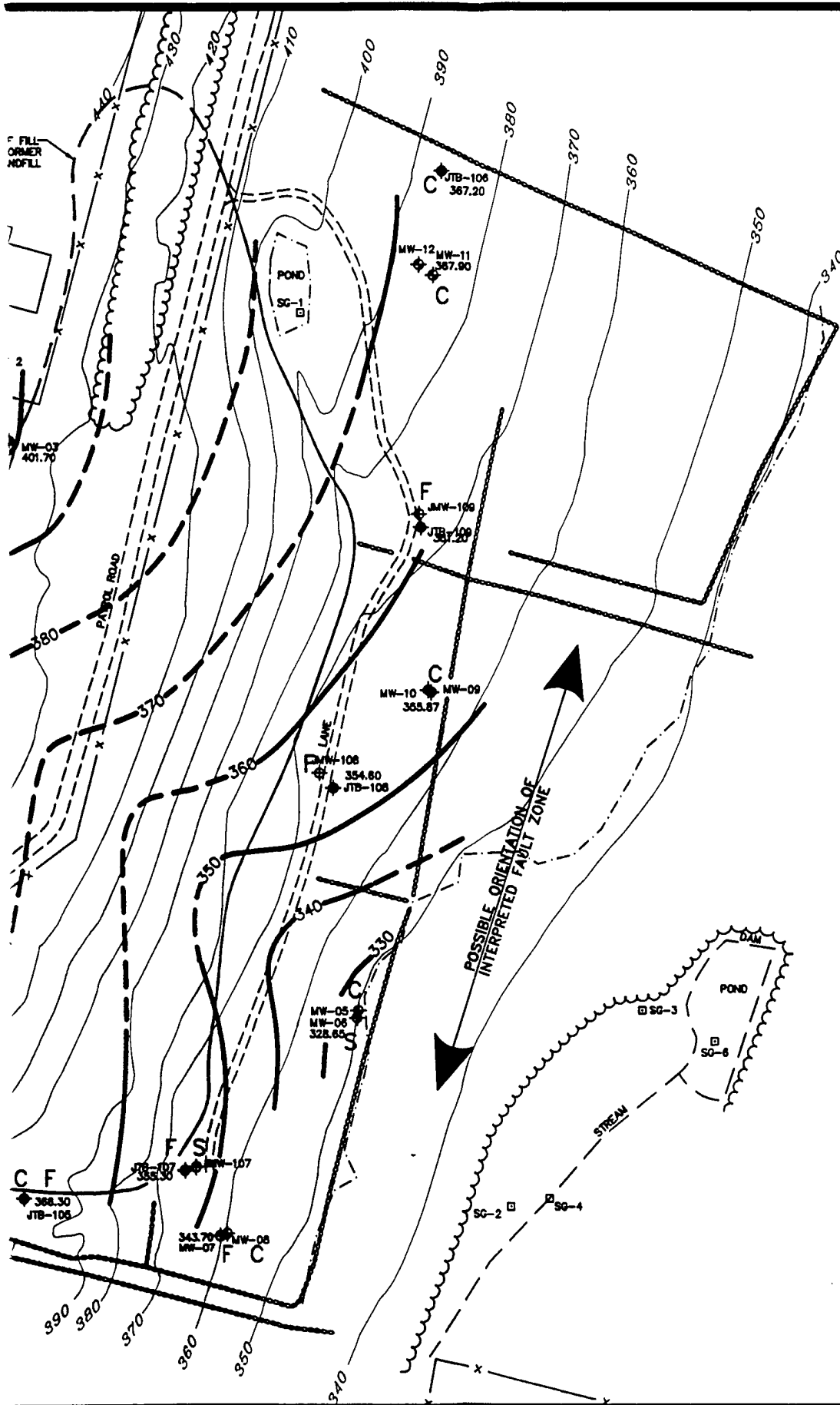
bgs - below ground surface

msl - mean sea level

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①



KEY

- S Slickensides in rock
- C Calcite veins in rock
- F High degree of fracturing

LEGEND

- Bedrock Surface (dashed where in contact with groundwater)
- Groundwater Surface
- SI Piezometer Cluster
- SI Monitoring Well
- Monitoring Well
- Soil Boring
- Staff Gage
- Chain Link Fence
- Stone Wall
- Wetland Boundary
- Edge of woods

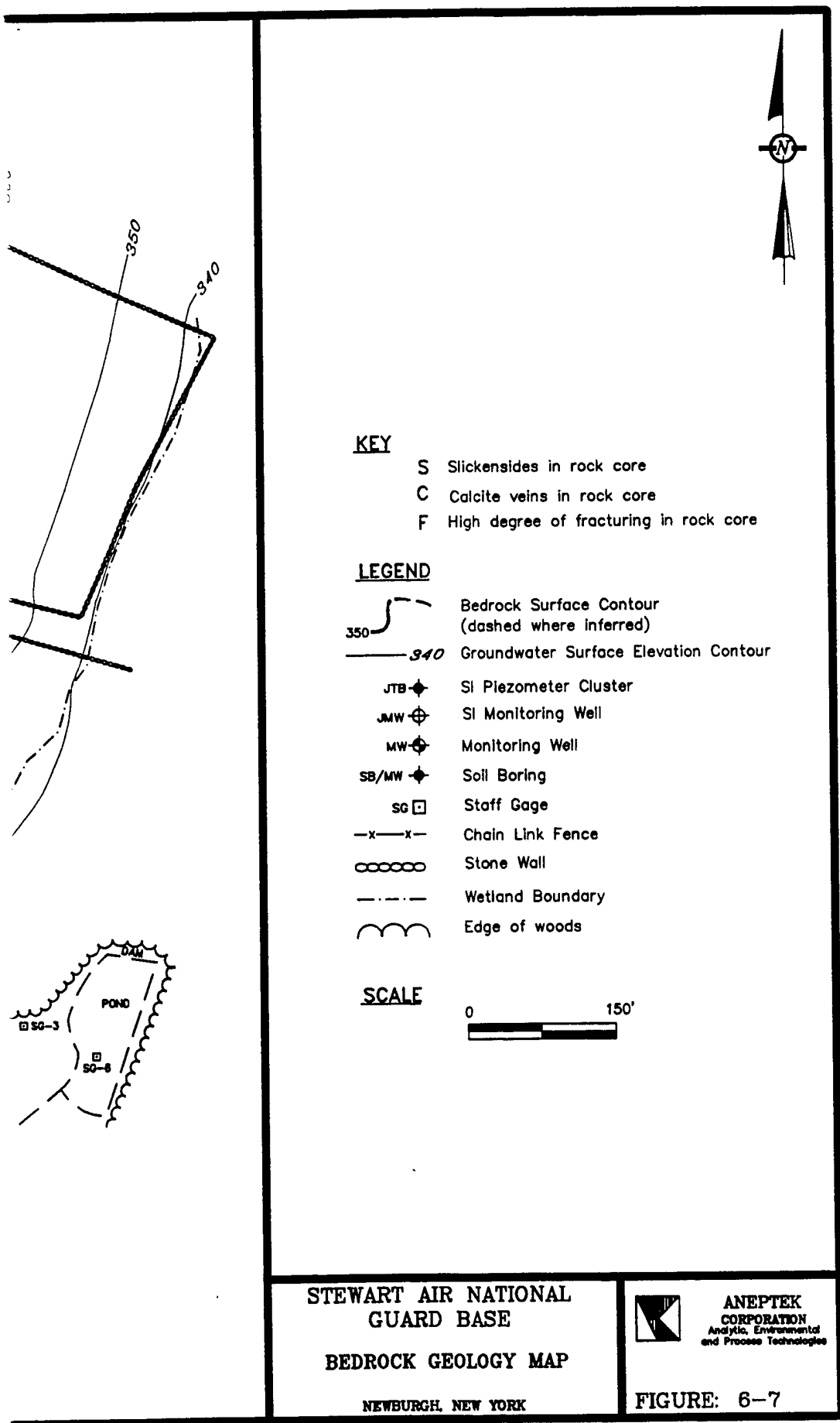
SCALE



STEWART AIR NATIONAL
GUARD BASE

BEDROCK GEOLOGY MAP

NEWBURGH, NEW YORK



data indicate that a fault zone may exist east of Site 2, beneath the landfill. The potential orientation of this zone is illustrated by the arrow on Figure 6-7.

The probable presence of a fault is also indicated by larger scale lineaments indicated by topography. Figure 6-8 is derived from the United States Geological Survey (USGS) quadrangle maps that encompass the study area. Superimposed on this map is a rectangle encompassing the original topography of the eastern area of the Base obtained from the Base grading plans (USACE, 1943). Lineaments observed on the USGS topographic map are marked in black. A lineament identified in the original topography is bracketed by two arrow heads. The figure shows that the north-northeast trending lineament observed in the original topography appears to be an extension of a lineament on the east side of a drumlin to the northeast of the Base as well as the drumlin formerly present in the vicinity of Site 2 which was removed in the 1940's as illustrated in Figure 6-7. These lineaments support the interpretation that a fracture zone or fault is present in the vicinity of the study area.

6.1.2 Hydrogeology

This section presents and summarizes the basic hydrologic properties of the groundwater flow system in the study area. The evaluation of site hydrogeology included: (1) the distribution of hydraulic head in both the bedrock and overburden aquifers based on measurements obtained during December 1995, March 1996 and April 1996; (2) calculation of vertical and horizontal hydraulic gradient; (3) estimation of effective porosity; (4) calculation of hydraulic conductivity; (5) calculation of average linear (seepage) velocity; and (6) surface water measurements.

Table 6-2 presents a summary of well construction information for all existing and newly installed wells in the study area that were utilized during this investigation. Piezometers and well clusters JTB-101/JMW-101 and JTB-104 installed during the SI were destroyed. In addition, JTB-102 could not be located during this investigation and is presumed destroyed. All water level data are summarized in Table 6-3. Supporting calculations used to determine the projected water table elevations are provided in Appendix F, Tables F-1 through F-3. Section 6.1.2.1 describes the rationale and methodology followed in calculating the projected water table elevations.

In general, groundwater flow in the study area can be separated into two interconnected flow systems: an upper flow system in the overburden, and a lower system in the underlying fractured bedrock. The hydrogeologic stratigraphy and piezometric data of the study area are illustrated in Figures 6-2 through 6-6. The figures illustrate that, in most cases, total head in piezometers or well clusters varies significantly between the overburden and bedrock stratigraphic units; therefore, vertical flow is an important component of the study area subsurface hydrology.

The lodgement till appears to be a low permeability unit, especially in the vicinity of Site 2 where the unweathered portion of the till is very thick (greater than 20 feet). Further to the east and downgradient of the site, the unweathered and weathered till are probably transmissive to some extent given the observed hydraulic conductivities in both formations (see Section 6.1.2.4).

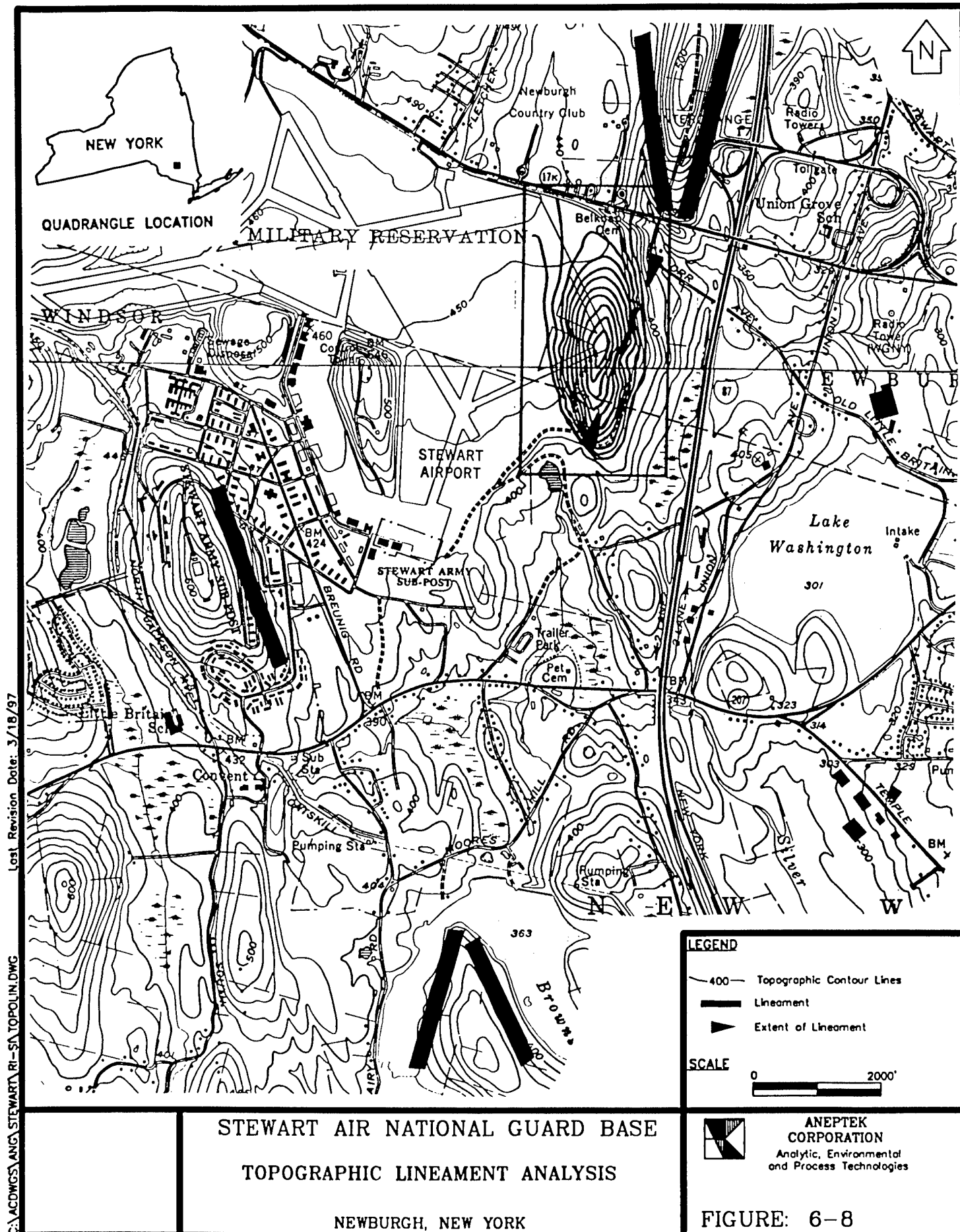


TABLE 6-2
WELL CONSTRUCTION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

WELL/PIEZOMETER DESIGNATION	REFERENCE POINT	NORTHING	EASTING	GROUND SURFACE ELEVATION (ft msl)	REFERENCE POINT ELEVATION (ft msl)	RISER HEIGHT ABOVE GROUND SURFACE (ft)	DEPTH TO TOP OF SCREEN (ft bgs)	ELEVATION TOP OF SCREEN (ft msl)	DEPTH TO BOTTOM OF SCREEN (ft bgs)	ELEVATION BOTTOM OF SCREEN (ft msl)	ELEVATION CENTER OF SCREEN (ft msl)	TOTAL DEPTH OF BORING (ft bgs) ¹
MW-01	Top PVC	546067.50	568494.86	436.40	438.49	2.09	37.00	399.40	42.00	397.40	396.90	42.50
MW-04	Top PVC	545635.45	568377.81	434.20	436.29	2.09	51.00	383.20	56.00	382.20	380.70	72.50
MW-05	Top PVC	545386.81	569141.95	349.90	352.28	2.38	30.00	319.90	35.00	314.90	317.40	35.70
MW-06	Top PVC	545379.11	569140.65	347.90	352.53	4.63	5.00	342.90	10.00	337.90	340.40	10.40
MW-07	Top PVC	545159.95	568999.12	360.10	362.77	2.67	24.75	335.35	29.75	330.35	332.85	30.90
MW-08	Top PVC	545163.32	569006.95	359.40	362.14	2.74	11.30	348.10	16.30	343.10	345.60	16.80
MW-09	Top PVC	545707.49	569215.77	366.20	368.81	2.61	17.50	348.70	22.50	343.70	346.20	26.00
MW-10	Top PVC	545709.25	569212.22	366.20	368.39	2.19	4.00	362.20	9.00	357.20	359.70	9.50
MW-11	Top PVC	546123.29	569216.33	385.90	388.69	2.79	22.70	363.20	27.70	358.20	360.70	28.40
MW-12	Top PVC	546134.05	569201.45	387.20	389.78	2.58	5.00	382.20	10.00	377.20	379.70	11.00
MW-13	Top PVC	545914.49	568747.42	433.10	435.32	2.22	7.00	426.10	17.00	416.10	421.10	20.00
SW-2	Top Casing	545957.68	568735.43	433.80	435.58	1.78	40.00	393.80	50.00	383.80	388.80	50.00
SW-3	Top Casing	545965.67	568784.06	434.00	434.19	0.19	35.00	399.00	45.00	389.00	394.00	49.50
JMW-107	Top PVC	545229.41	568973.75	364.10	367.04	2.94	4.38	359.72	9.38	354.72	357.22	9.50
JMW-108	Top Casing	545625.69	569101.83	368.10	370.70	2.60	5.97	362.13	10.97	357.13	359.63	12.00
JMW-109	Top PVC	545385.15	569202.79	371.80	374.15	2.35	5.25	366.55	10.25	361.55	364.05	11.00
JTB-100 (a)	Top PVC	545614.25	568368.71	433.90	436.00	2.10	50.50	383.40	52.50	381.40	382.40	55.60
JTB-100 (b)	Top PVC	545614.25	568368.71	433.90	436.24	2.34	42.50	391.40	44.50	389.40	390.40	45.60
JTB-103 (a)	Top Casing	545792.41	568708.36	432.60	435.53	2.93	49.30	383.30	51.30	381.30	382.30	51.40
JTB-103 (b)	Top Casing	545792.41	568708.36	432.60	435.53	2.93	39.90	392.70	41.90	390.70	391.70	44.00
JTB-105 (a)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	34.60	357.20	36.60	355.20	356.20	38.00
JTB-105 (b)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	23.10	368.70	25.10	366.70	367.70	26.30
JTB-105 (c)	Top Casing	545198.81	568795.85	391.80	394.43	2.63	14.10	377.70	16.10	375.70	376.70	17.20
JTB-106 (a)	Top Casing	546227.65	569224.44	386.80	389.85	3.05	25.80	361.00	27.80	359.00	360.00	30.00
JTB-106 (b)	Top Casing	546227.65	569224.44	386.80	389.85	3.05	16.80	370.00	18.80	368.00	369.00	19.50
JTB-107 (a)	Top Casing	545225.95	568692.27	364.70	367.92	3.22	15.90	348.80	17.90	346.80	347.80	19.40
JTB-107 (b)	Top Casing	545225.95	568692.27	364.70	367.92	3.22	5.50	359.20	7.50	357.20	358.20	8.00
JTB-108 (a)	Top Casing	545610.97	569116.04	367.40	370.31	2.91	19.60	347.80	21.60	345.80	346.80	22.80
JTB-108 (b)	Top Casing	545610.97	569116.04	367.40	370.31	2.91	10.60	356.80	12.60	354.80	355.80	14.80
JTB-109 (a)	Top Casing	545871.82	569204.75	371.60	373.96	2.36	17.30	354.30	19.30	352.30	353.30	19.40
JTB-109 (b)	Top Casing	545871.82	569204.75	371.60	373.96	2.36	7.70	363.90	9.70	361.90	362.90	13.00

NOTES ¹ Total depth of boring for multi-level piezometers indicate depth to bottom of boring for (a)-well screened in weathered shale ;
(b) and (c)- wells screened in overburden at different intervals.

ABBREVIATIONS
bgs - below ground surface
ft - feet
msl - mean sea level
PVC - pvc inside protective casing

TABLE 6-3
GROUNDWATER ELEVATION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MEASUREMENT LOCATION	GROUNDWATER ELEVATION 12/8/95 (ft msl)	GROUNDWATER ELEVATION 3/19/96 (ft msl)	GROUNDWATER ELEVATION 4/9/96 (ft msl)
MW-01	406.81	407.39	407.37
MW-04	405.89	406.33	406.30
MW-05	349.17	350.39	350.24
MW-06	348.35	349.16	348.79
MW-07	355.00	356.97	356.70
MW-08	353.54	355.70	355.28
MW-09	357.64	361.09	360.52
MW-10	363.44	365.46	364.59
MW-11	371.95	374.51	374.09
MW-12	383.50	386.26	386.63
MW-13	423.12	423.94	423.67
SW-2	410.93	411.99	411.42
SW-3	410.76	411.64	411.48
JMW-107	NM	NM	362.77
JMW-108	367.73	368.62	368.46
JMW-109	370.45	371.37	371.33
JTB-100 (a)	424.39	NM	426.67
JTB-100 (b)	407.73	NM	407.53
JTB-103(a)	414.75	408.23	407.12
JTB-103 (b)	411.39	408.30	407.47
JTB-105 (a)	NM	NM	380.75
JTB-105 (b)	NM	NM	380.97
JTB-105 (c)	NM	NM	384.76
JTB-106 (a)	374.38	377.95	377.01
JTB-106 (b)	374.81	378.10	377.36
JTB-107 (a)	361.14	362.44	361.94
JTB-107 (b)	361.17	362.99	361.96
JTB-108 (a)	NM	NM	365.87
JTB-108 (b)	NM	NM	365.69
JTB-109 (a)	369.76	370.67	370.81
JTB-109 (b)	370.27	370.81	371.09
SG-01	390.31	NM	390.83
SG-02	334.95	NM	335.05
SG-03	333.82	NM	333.84
SG-04	334.15	NM	334.29
SG-06	331.25	NM	332.57

ABBREVIATIONS

ft - feet

NM - not measured

NOTES:

1) Groundwater elevation calculations are found in Appendix F, Tables F1 through F3.

2) Piezometer designation:

(a)- screened in weathered shale;

(b) and (c)- screened in overburden at different intervals

Because contamination was observed at Site 2 and the deeper unweathered till was essentially unsaturated at the time upgradient borings were performed (such as the MW-04 location), no monitoring wells were installed; therefore it was not possible to evaluate the hydrologic properties of the unweathered till interval in the immediate vicinity of Site 2 during this investigation.

6.1.2.1 Horizontal Flow and Gradients

Figures 6-9 and 6-10 show the interpreted piezometric surface of both the projected water table and the shallow fractured bedrock, respectively, based on water level measurements obtained during April 1996 (Table 6-3). Only those contours based on the April 1996 measurement round are presented in this report because this data set contains the most complete set of measurements. Water levels were not obtained from some of the monitoring wells and/or staff gages during the previous measurement rounds.

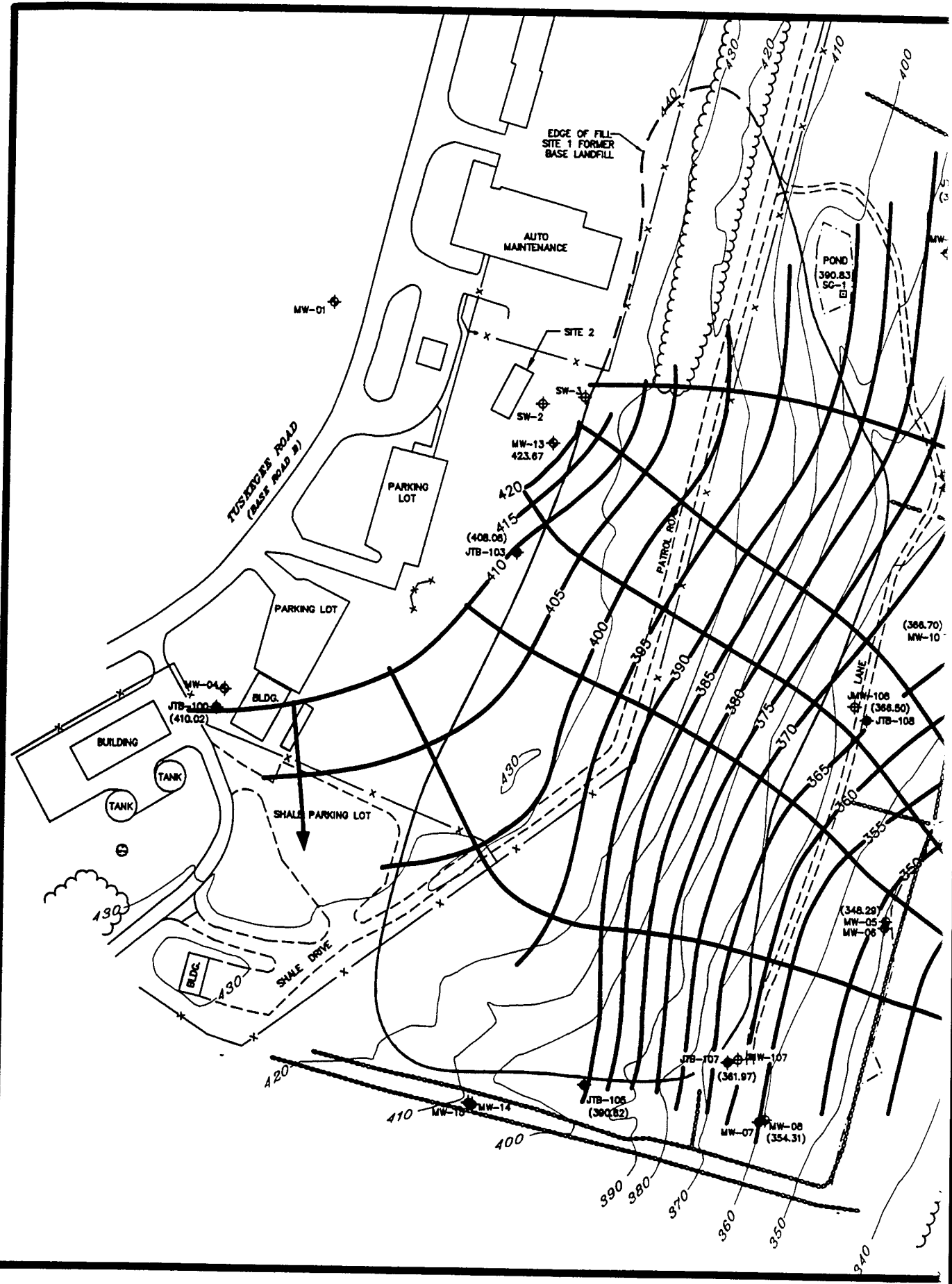
In order to evaluate the connection between downgradient surface water bodies and the subsurface, Figure 6-10 shows the projected water table instead of the piezometric surface of the deep overburden. This evaluation was performed because, given the substantial vertical gradients observed in the study area (see Section 6.1.2.2) and the fact that the deeper overburden wells were not all screened in the same depth interval, the head data from these wells did not represent the same portion of the aquifer. A description of the calculations used to determine the projected water table are presented in Appendix F. These calculations assume that vertical gradients are constant throughout the water column, which is reasonable for most well clusters in the study area. Exceptions are noted in the following discussion of vertical gradients.

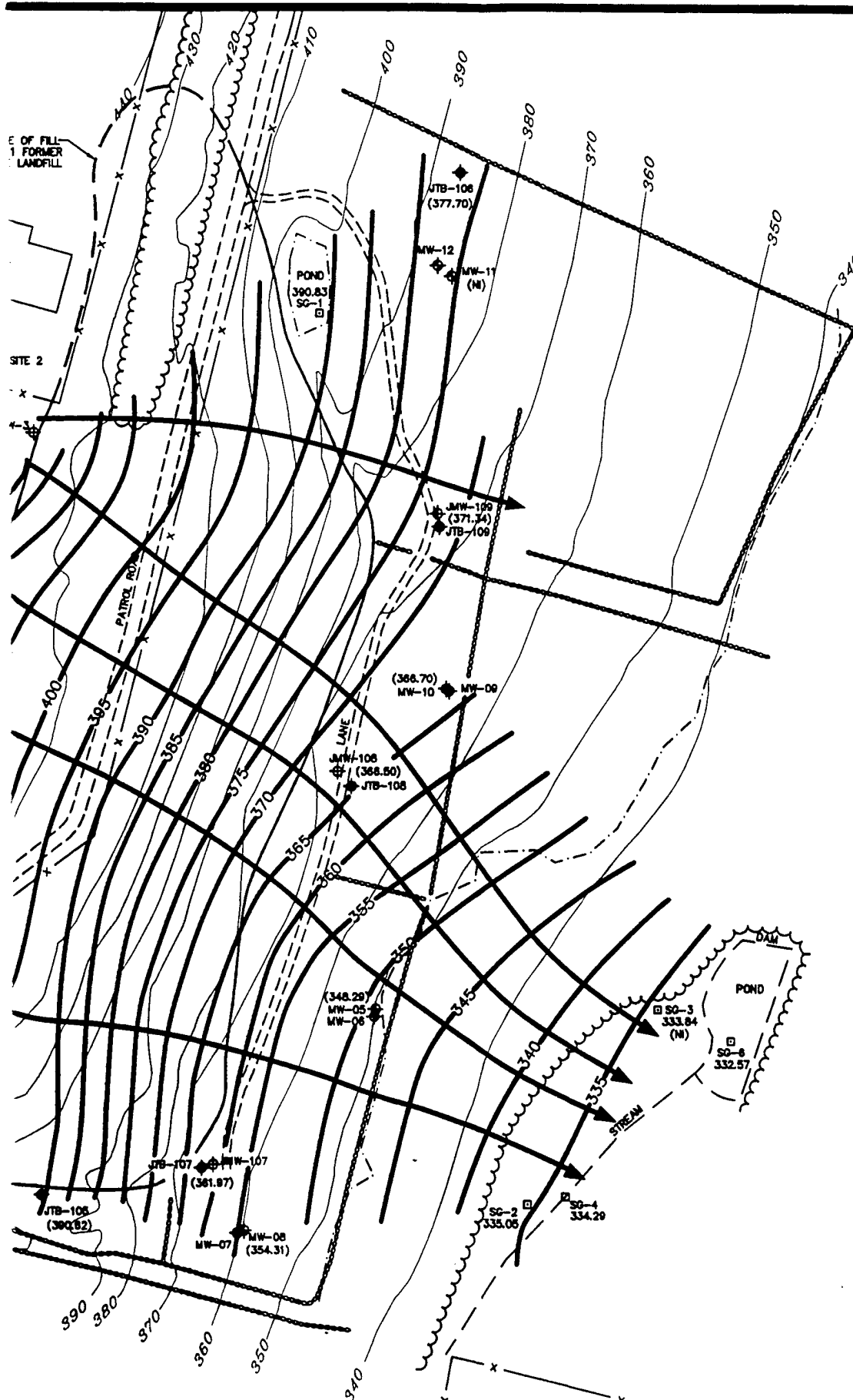
Two significant observations are made. First, both Figures 6-9 and 6-10 show groundwater flow to the east or east-southeast towards the local topographic low. In the overburden, flow lines originating from the vicinity of Site 2 terminate in the vicinity of Murphy's Gulch. A southeastern component of flow is interpreted in the bedrock in the southern portion of the study area that is not interpreted in the overburden. The data indicate that a component of flow in the bedrock that originates from Site 2 could flow to the southern portion of the study area.

The other significant observation is the presence of a groundwater high in the bedrock in the vicinity of Site 2. The current distribution of wells suggest that groundwater flows radially from Site 2. The bedrock piezometric high may be a purely local phenomenon caused by the presence of the PPBA. Site 2 lies in an area of lower surface relief in the open field. It is possible that the backfill in the PPBA is not compacted as densely as the surrounding existing soils, thus possessing locally higher hydraulic conductivity and higher storage capacity than the surrounding till material into which the pit was excavated. Surface runoff entering this area could infiltrate more readily into the subsurface and be impeded from immediate further downward flow by the lower hydraulic conductivity natural soils, leading to a "mounding" condition. It is probable that this observed groundwater high is not a regional condition, given the steady increase in surface elevation to the west and northwest of the study area, and the fact that the site is located on the far east side of a pre-existing drumlin.

Last Revision Date: 3/18/97

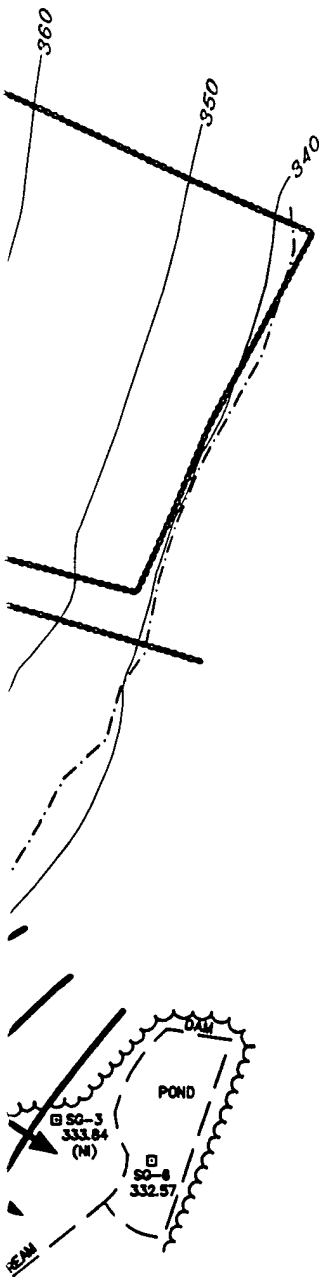
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STEWART AIR NATIONAL
 GUARD BASE
 WATER TABLE
 CONTOUR MAP 4/9/96

NEWBURGH, NEW YORK



KEY

NI Not Included

LEGEND

- JTB-103 (408.08) ◆ Projected Water Table Elevation
- MW-13 (408.08) ⊕ Actual Water Table Elevation
- JTB ◆ SI Piezometer Cluster
- JMW ⊕ SI Monitoring Well
- MW ⊕ Monitoring Well
- SW ⊕ SI Monitoring Well
- SG □ Staff Gage
- 340 — Ground Surface Elevation Contour
- x-x- Chain Link Fence
- Stone Wall
- - - Wetland Boundary
- ~ Edge of woods
- 360 — Interpreted Groundwater Elevation Contour
- Interpreted Groundwater Flow Line

NOTES

- 1) Measurements from MW-12 were not included because the projected water table elevation would have been over 10 feet above ground surface. See text for further explanation.
- 2) Measurements from SG-3 were not included because field observations indicated that the surface water elevation reflects overland flow, not aquifer conditions.

SCALE



STEWART AIR NATIONAL
GUARD BASE
WATER TABLE
CONTOUR MAP 4/9/96

NEUBURGH, NEW YORK

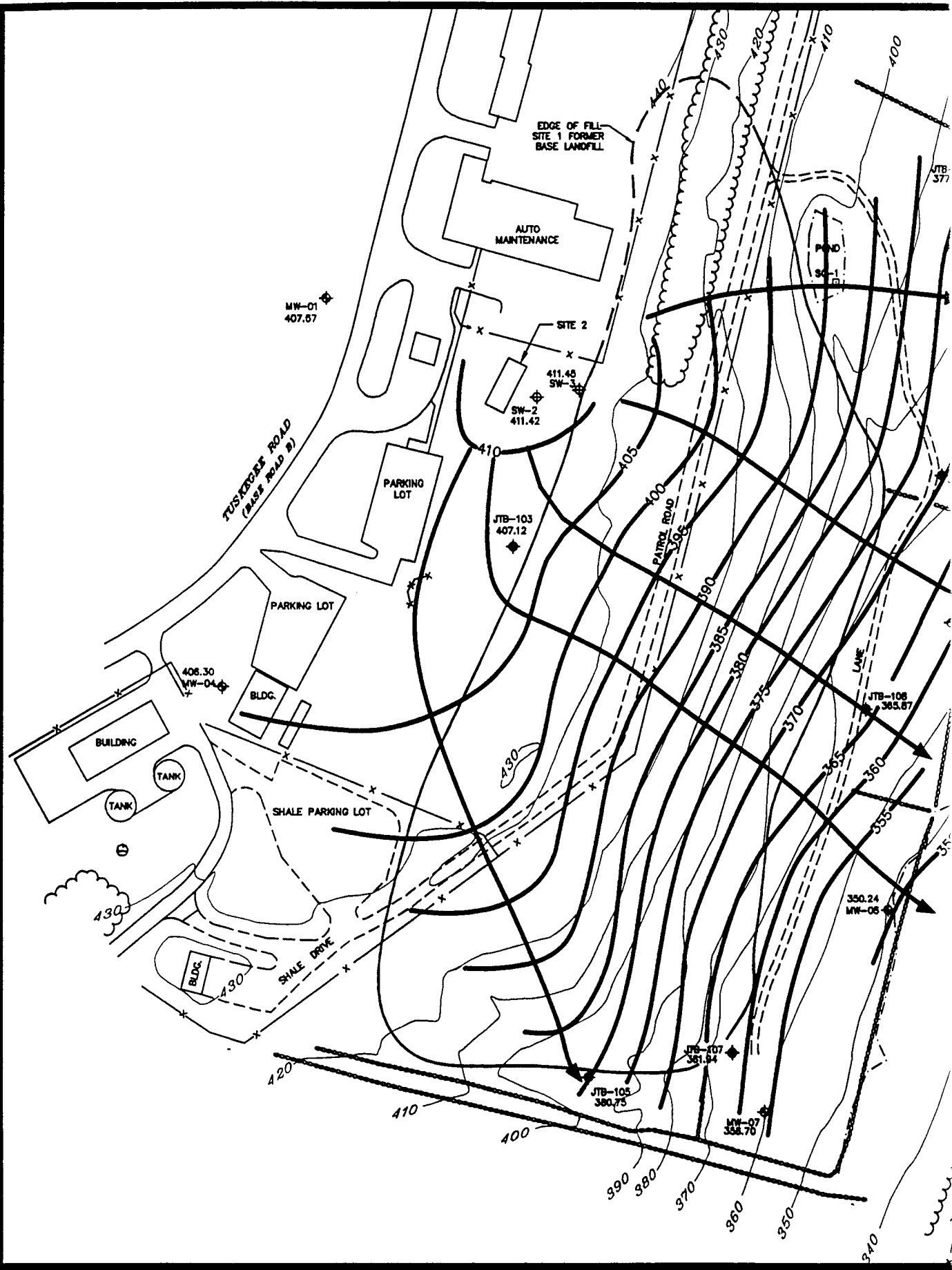


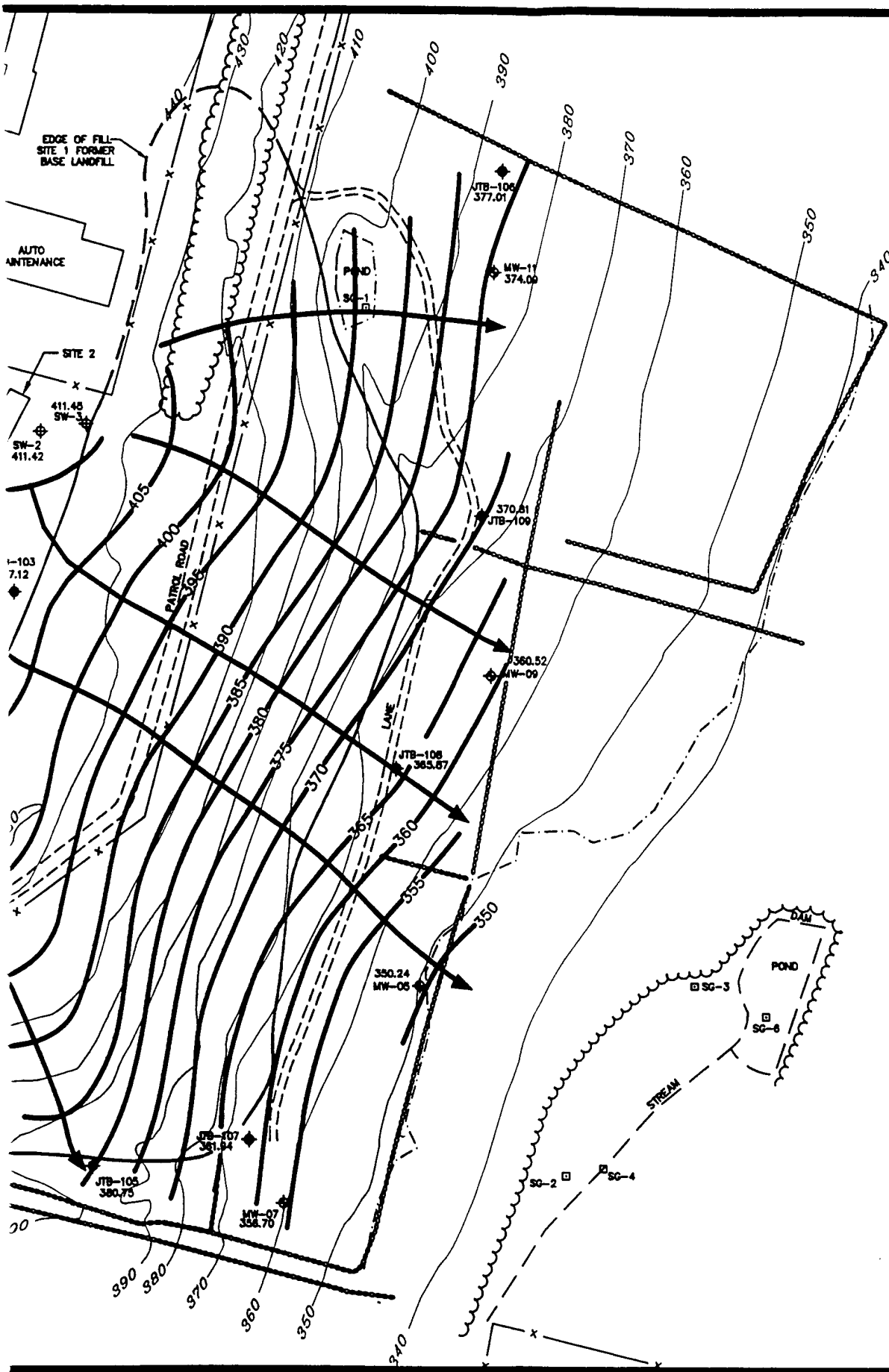
ANEPTEK
CORPORATION
Analytic, Environmental
and Process Technologies

FIGURE: 6-9

Last Revision Date: 3/18/97

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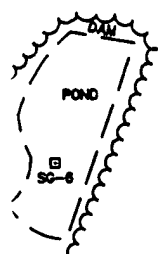
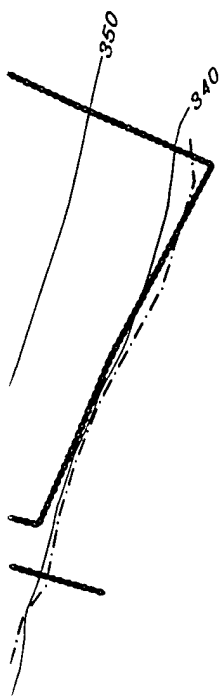
LEGEND

- MW-08 Well with w
in ft msl (4
- JTB SI Piezomet
- JMW SI Monitoring
- MW Monitoring
- SW SI Monitoring
- SG Staff Gage
- 340 Ground Sur
- Chain Link
- Stone Wall
- Wetland Bo
- Edge of wo
- Interpreted
- Interpreted

SCALE



STEWART AIR NATION
GUARD BASE
BEDROCK GROUNDWA
CONTOUR MAP 4/9/
NEWBURGH, NEW YORK



LEGEND

- MW-09 357.64 Well with water level elevation in ft msl (4/9/96)
- JTB SI Peizometer Cluster
- JMW SI Monitoring Well
- MW Monitoring Well
- sw SI Monitoring Well
- SG Staff Gage
- 340 — Ground Surface Elevation Contour
- x-x- Chain Link Fence
- — — — — Stone Wall
- . - . - . Wetland Boundary
- ~~~~~ Edge of woods
- Interpreted Groundwater Elevation Contour
- Interpreted Groundwater Flow Line

SCALE



STEWART AIR NATIONAL
GUARD BASE

BEDROCK GROUNDWATER
CONTOUR MAP 4/9/96

NEWBURGH, NEW YORK



ANEPTEK
CORPORATION
Analytic, Environmental
and Process Technologies

FIGURE: 6-10

In both the overburden and bedrock, the interpreted horizontal gradient east of Site 2 is approximately 0.11 in the area of the steep slopes beneath Site 1. Further east in the overburden (beneath the wetlands), the horizontal gradient is interpreted to be approximately 0.06, or approximately half the gradient interpreted beneath the landfill.

6.1.2.2 Vertical Gradients

Table 6-4 summarizes the vertical gradient calculations for each round of water level measurements. Vertical gradient calculations are presented in Appendix F.

Figure 6-11 and 6-12 are vertical flow net cross sections constructed along two cross sections through the central and southern portions of the study area to evaluate: (1) how groundwater flows, and (2) how vertical gradients vary. The flow nets were constructed by posting total head elevation at the elevation head elevation at each well screen. Where applicable, projected water table elevations were also posted on the sections. Piezometric contours were constructed by linear interpolation. Flow lines were added to the nets, taking into account the 6:1 vertical to horizontal exaggeration of the cross section using methodology developed by van Everdingen (1963).

In most cases, vertical gradients in well pairs were consistent in both direction and magnitude during the three measurement rounds. Table 6-4 shows strongly downward gradients (in the 0.1 to 0.01 magnitude) in the vicinity of Site 2 and at topographically higher elevations elsewhere in the study area. Vertical gradients remain downwards in well clusters at lower elevations of the study area that are located more than 140 feet from the wetlands boundary. Upward gradients were observed at JTB-108, MW-05/06 and MW-07/08, all of which are located in the vicinity of the wetlands west of Murphy's Gulch in the southern portion of the study area.

The flow net cross sections in Figures 6-11 and 6-12 illustrate the vertical flow pattern in this study area. Downward gradients persist until the approximate toe of the landfill, downgradient of Site 2 where flow is almost horizontal (such as at JTB-107 or JTB-108), then are strongly upwards towards the wetlands and Murphy's Gulch. The flow nets support the interpretation that the wetlands and Murphy's Gulch receive recharge from both the overburden and bedrock flow systems. In addition, Figure 6-11 shows very steep vertical gradients in the vicinity of JTB-105, based on the 4-foot head difference observed in JTB-105(c) versus (a) or (b). Similar head differentials were also observed during the SI (Appendix A, Table 7-3). The data in this area suggest local resistance to vertical flow through the till as groundwater discharges from the relatively permeable fill.

The data suggest that groundwater entering the overburden at Site 2 would migrate vertically to the fractured bedrock flow system and flow through bedrock to the point where gradients reverse and then flow upwards, discharging to the overburden and eventually to surface water.

TABLE 6-4
VERTICAL GRADIENT COMPARISON
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

WELL PAIR	Dec-95 VERTICAL GRADIENT (ft/ft)	Mar-96 VERTICAL GRADIENT (ft/ft)	Apr-96 VERTICAL GRADIENT (ft/ft)
MW-05 MW-06	0.0357	0.0535	0.0630
MW-07 MW-08	0.1145	0.0996	0.1114
MW-09 MW-10	-0.4296	-0.3237	-0.3015
MW-11 MW-12	-0.6079	-0.6184	-0.6600
SW-2 MW-13	-0.3552	-0.3401	-0.3513
MW-04 JTB-100 (b)	-0.1897	NM	-0.1268
JTB-103(a) JTB-103 (b)	0.3574	-0.0074	-0.0372
JTB-105 (a) JTB-105 (b) JTB-105 (c)	NM NM	NM NM	-0.0191 -0.4211
JTB-106 (a) JTB-106 (b)	-0.0478	-0.0167	-0.0389
JTB-107 (a) JTB-107 (b)	-0.0029	-0.0529	-0.0019
JTB-108 (a) JTB-108 (b)	NM	NM	0.0200
JTB-109 (a) JTB-109 (b)	-0.0531	-0.0146	-0.0292

ABBREVIATIONS

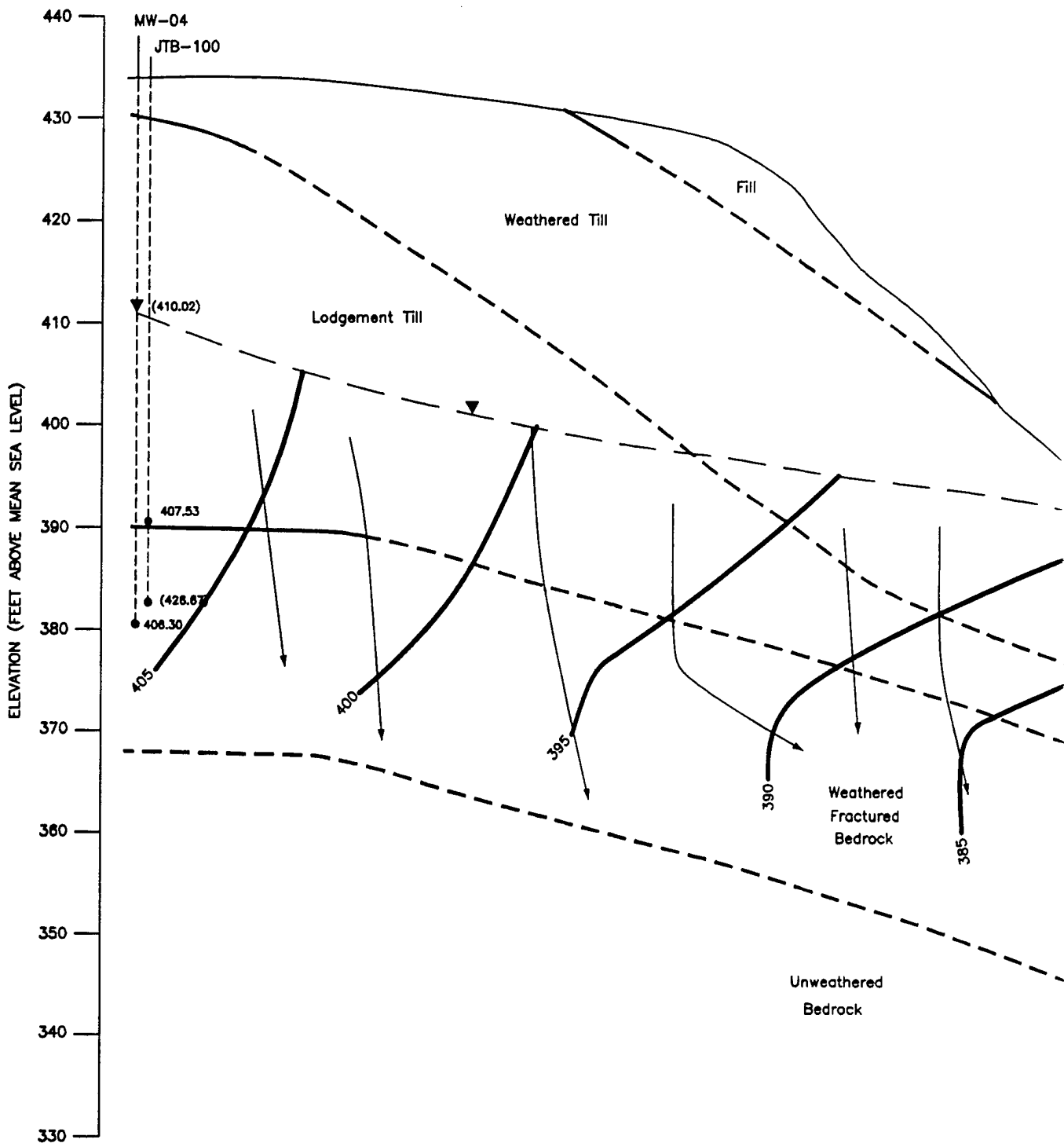
NM - Water levels not measured.
ft - feet

NOTES

By convention a positive gradient indicates an upward gradient, and a negative gradient indicates a downward gradient.

See Appendix F, Tables F-6, F-7, F-8 for calculations

D (west)



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STEWART AIR NATIONAL

FLOW NET CROSS SECTION

NEWBURGH, NEW YORK

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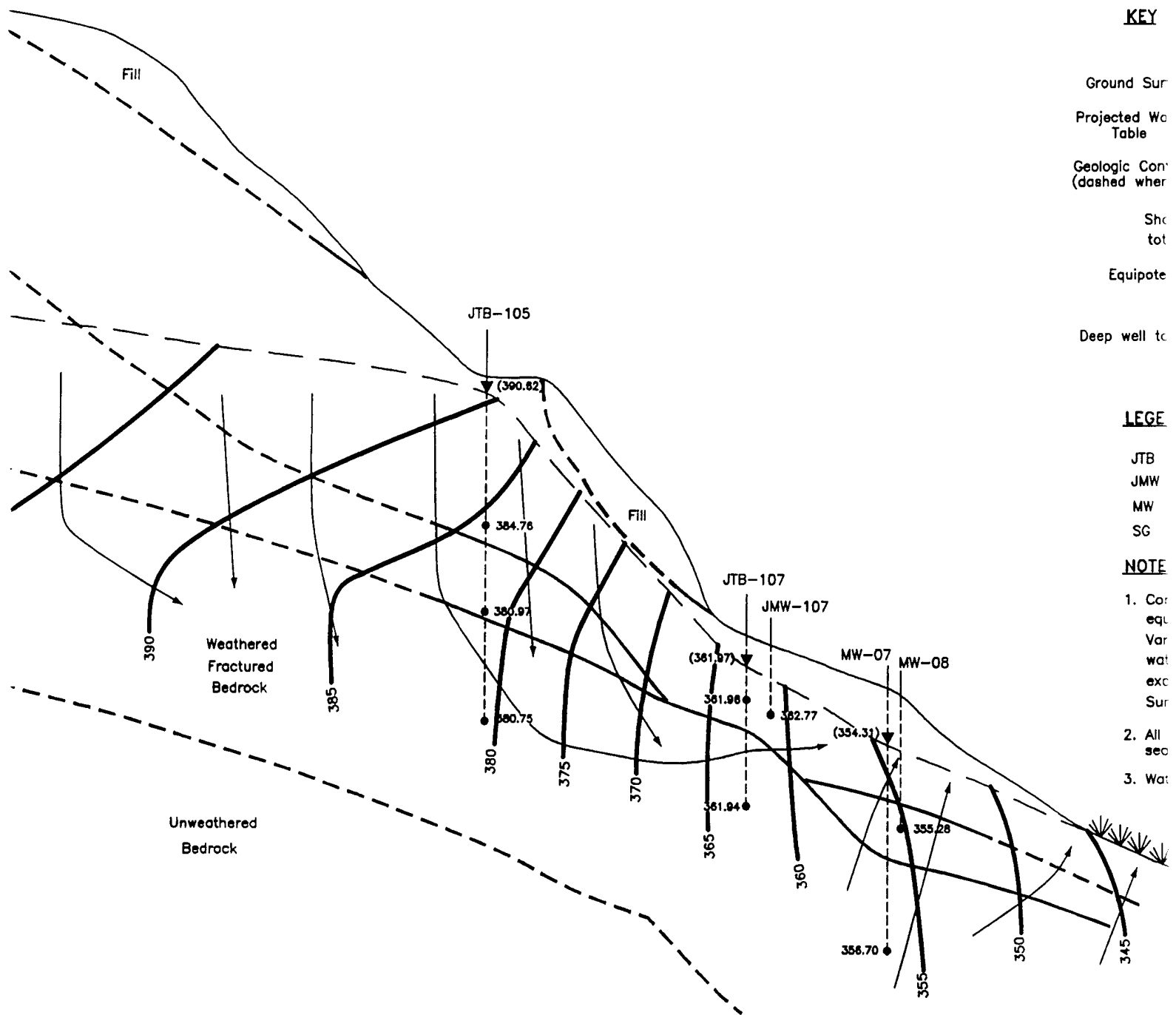
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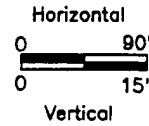
STEWART AIR NATIONAL GUARD BASE

FLOW NET CROSS SECTION D - D'

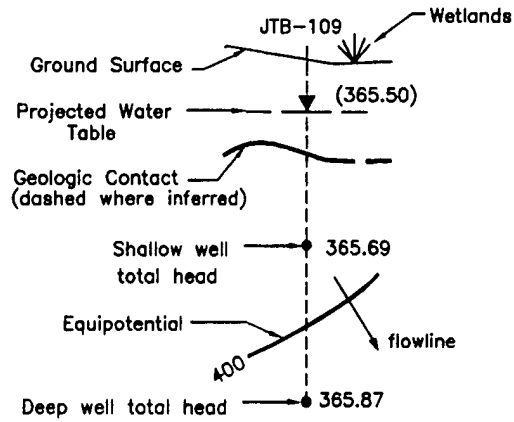
NEWBURGH, NEW YORK

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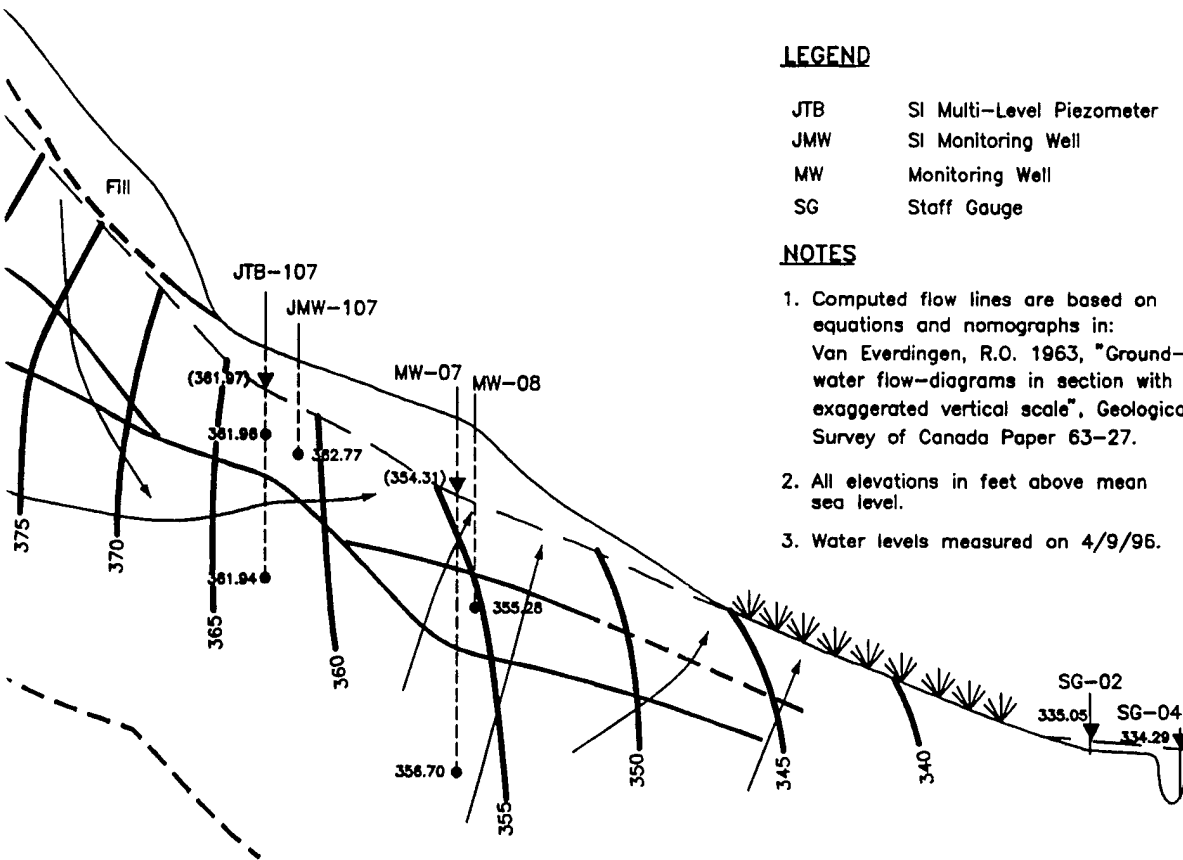


LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gauge

NOTES

1. Computed flow lines are based on equations and nomographs in: Van Everdingen, R.O. 1963, "Ground-water flow-diagrams in section with exaggerated vertical scale", Geological Survey of Canada Paper 63-27.
2. All elevations in feet above mean sea level.
3. Water levels measured on 4/9/96.



BASE

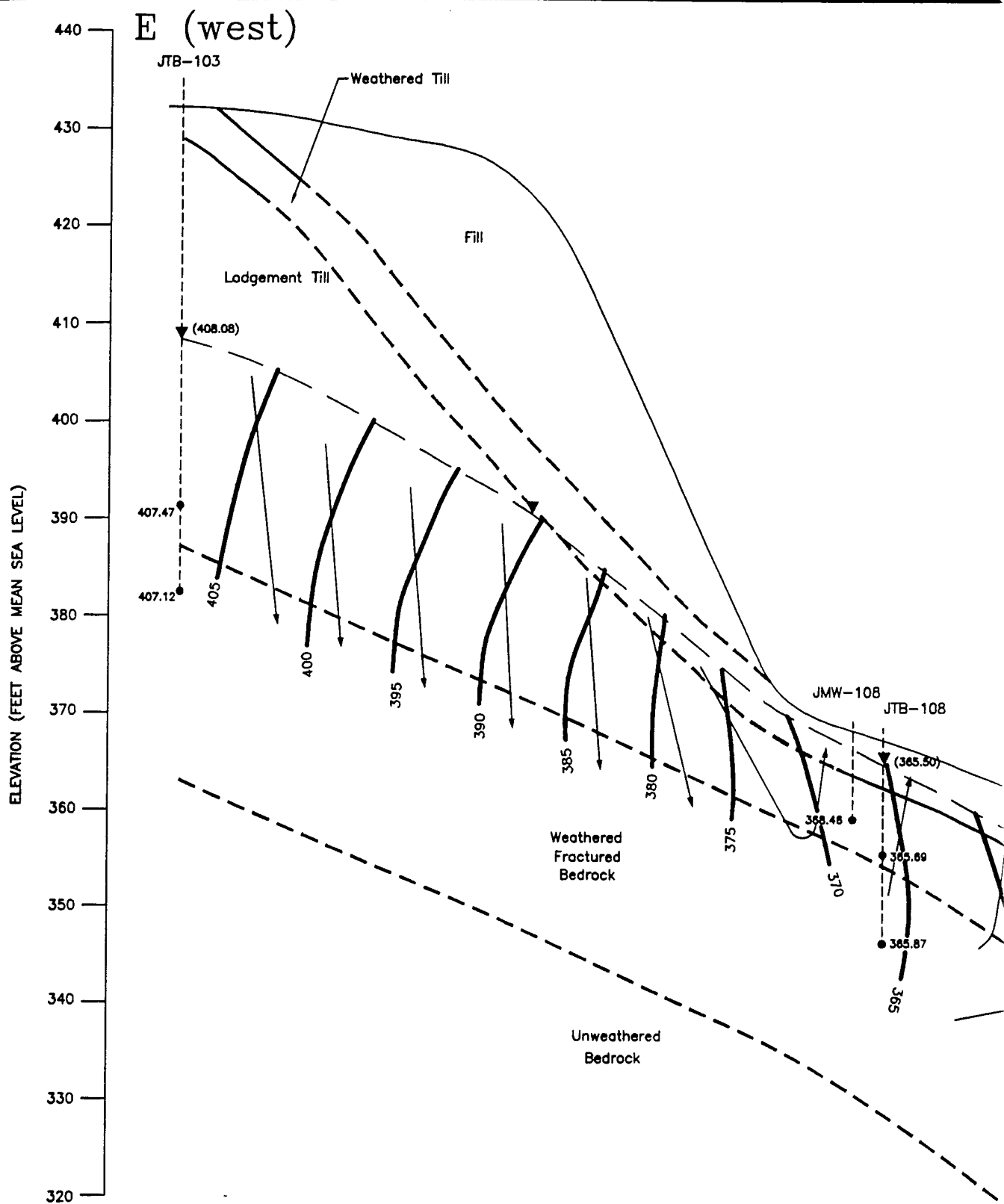


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FIGURE: 6-11

Last Revision Date: 3/18/97

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STEWART AIR NATIONAL

FLOW NET CROSS SECTION

NEWBURGH, NEW YORK

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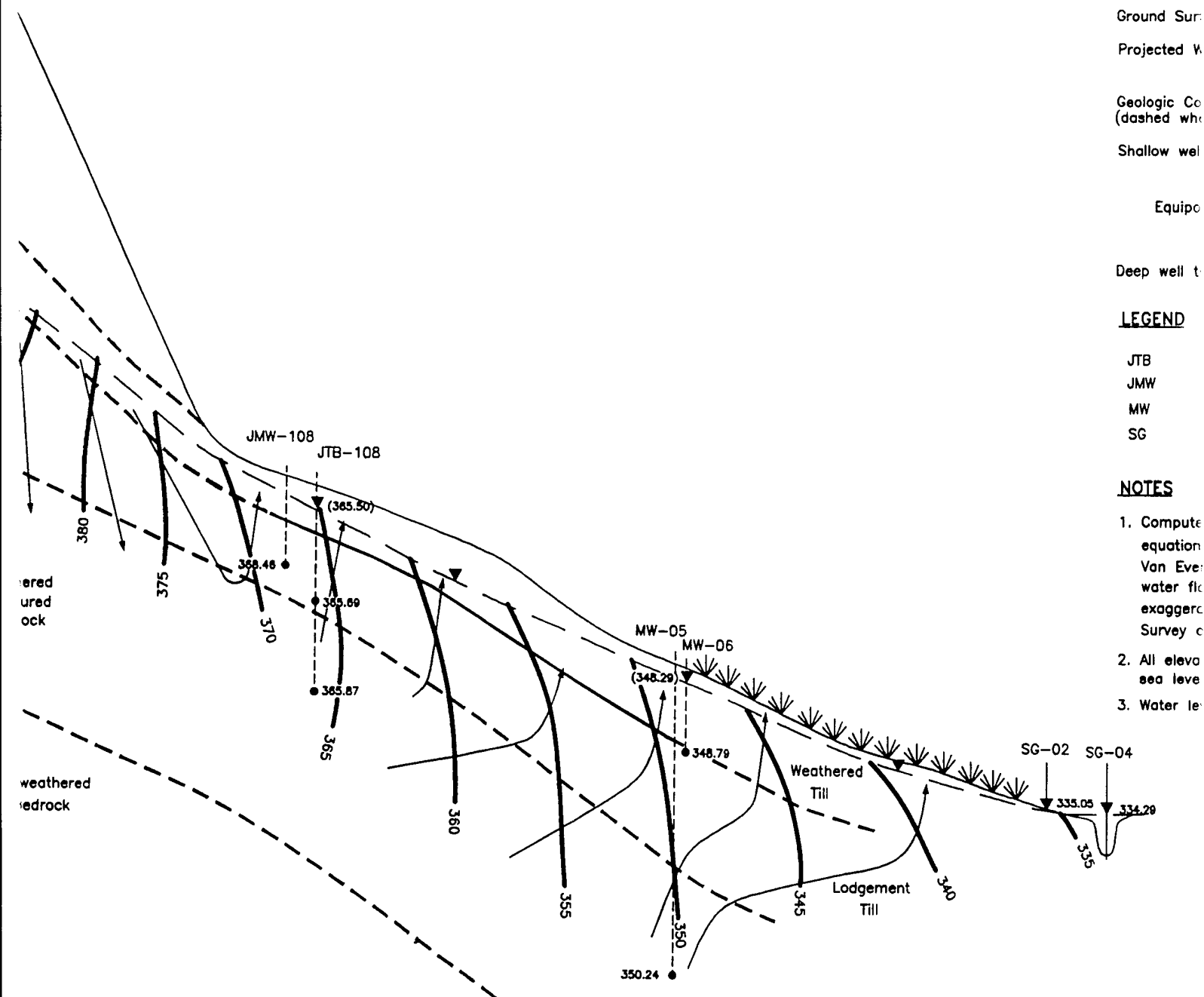
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NOTES

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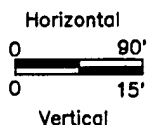
STEWART AIR NATIONAL GUARD BASE

FLOW NET CROSS SECTION E - E'

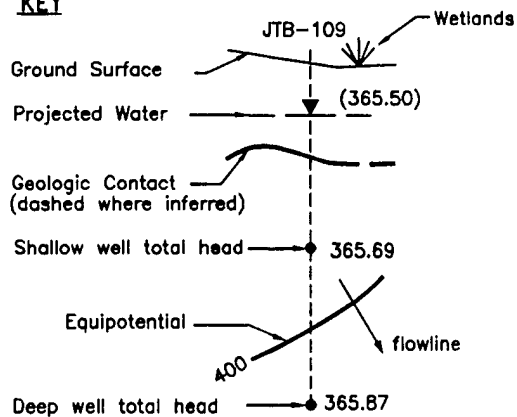
NEWBURGH, NEW YORK

E' (east)

SCALE



KEY

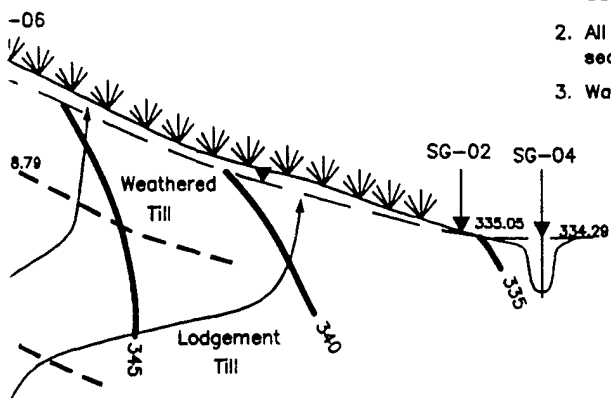


LEGEND

JTB	SI Multi-Level Piezometer
JMW	SI Monitoring Well
MW	Monitoring Well
SG	Staff Gauge

NOTES

1. Computed flow lines are based on equations and nomographs in: Van Everdingen, R.O. 1963, "Ground-water flow-diagrams in section with exaggerated vertical scale", Geological Survey of Canada Paper 63-27.
2. All elevations in feet above mean sea level.
3. Water levels measured on 4/9/96.



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FIGURE: 6-12

Substantial variations from the flow pattern described above were observed at three locations:

- At JTB-103, vertical gradients varied in both direction and magnitude during each measurement round. The same pattern was observed over successive measurements obtained during the SI (see Table 7-3 in Appendix A). The greatest head differential observed during the current investigation was December 1995 (3.36 feet). During the SI, a differential of 5.50 feet was observed in January 1989. The reason for this variation is not clear, but it may be related seasonal variations and to the location of the piezometer cluster near the westernmost limit of the local overburden aquifer. At the outset of this investigation during the fall of 1995, most of the overburden in the vicinity of Site 2 was unsaturated.
- At the MW-11/12 cluster, consistent strong downward vertical gradients were observed. The large head differential in this cluster (over 11 ft) may be due to the completion of MW-12 (the overburden well), in a very shallow interval of the overburden, compared to other piezometer or well clusters. The difference in completion intervals is illustrated in Figure 6-4, cross section B-B' across the base of the landfill toe. MW-12 was completed in this interval because groundwater was encountered at a comparatively shallow depth. When the companion MW-11 boring was being advanced, split spoons samples were saturated at 8 to 16 feet bgs, then were logged as slightly moist in deeper intervals. In addition, hydraulic conductivity measured at this cluster was the lowest observed in the study area 0.06 feet per day [ft/d]). A plausible explanation for this observation is that overburden groundwater at this location may be locally mounded due to downward seepage from the small retention pond located directly upgradient of the well cluster. Additionally, local till fractures may influence flow in this area. Note also that nearby JTB-106 (see Figure 6-3) does not exhibit this behavior.

Projecting the water table elevation at this cluster would lead to a water table at 400 feet msl (see Appendix F, Table F-5), which would be well above ground surface (387 feet msl). Overall, the data suggest that groundwater flow in the shallow overburden at the MW-11/12 cluster may be influenced by several factors and that the connection between MW-12 and the deeper overburden and bedrock flow systems is poor, especially when compared with nearby JTB-106. For this reason, overburden water level data from MW-12 were not used to determine the projected water table in this vicinity.

- A large head differential was observed in the JTB-100 cluster. The water level in bedrock piezometer JTB-100(a) was 20 feet higher than the overburden piezometer as well as the water level in nearby MW-04. This differential is illustrated in Figure 6-5. Because this large difference in head was not observed in measurements obtained during the SI (Appendix A, Table 7-3), it is assumed that the head in JTB-100(a) does not currently reflect aquifer conditions. Instead, to evaluate vertical gradients, comparisons were made between MW-04 and JTB-100(b). Vertical gradients in this area are consistently downward in the 0.1 ft/ft range, based on this comparison.

6.1.2.3 Effective Porosity

Effective porosity is defined as the volume of interconnected void spaces contributing to fluid flow in a porous medium, divided by the total volume of the medium (Fetter, 1988). No direct measurements of effective porosity were obtained for either the overburden or the bedrock in this study. However, available data can be used to derive an estimate of this property from literature values or formulas.

In the overburden, effective porosity can be estimated from grain-size data. Johnson (1967) provides several methods for using grain-size data to estimate formation specific yield, which is defined similarly to effective porosity in this publication. Several grain-size analyses were performed during the SI, the results of which are summarized in Table 6-5. This table shows that on average, the silt and clay fraction of the till comprises 44 percent of samples by weight. Although no hydrometer analyses were performed, it is reasonable to assume that approximately half the silt and clay percentage consists of clay-sized material, because the parent rock is predominantly shale, which is composed mostly of clay. Review of similarly sorted materials illustrated in Johnson (1967) suggest that the effective porosity of the till is probably in the range of 1 to no more than 10 percent.

Effective porosity in the fractured bedrock (n_f) was estimated by estimating the average number of fractures per unit foot of core (N), assuming an effective fracture aperture width (b) and applying these values to the following formula (Freeze and Cherry, 1979):

$$n_f = Nb$$

Based on a detailed inspection of the cores, the average number of fractures per foot is approximately 4. Assuming an in-situ aperture width of 1 millimeter (mm) to 5 mm (3.28×10^{-3} to 2×10^{-2} feet), based on the tightness of fit of reassembled core fragments, effective fracture porosity is estimated at 1 to 8 percent. Effective porosity is likely higher in the southern portion of the study area (in the vicinity of MW-07) where the core was so fractured the structure of the rock could not be evaluated.

6.1.2.4 Hydraulic Conductivity

Hydraulic conductivity (K) was estimated from slug tests performed in wells MW-04 through MW-13 installed during the RI and LFC SI. Additionally, all previous slug test data collected by other contractors were also reviewed. The original SI analyses used the wrong saturated well screen lengths, resulting in incorrect calculated hydraulic conductivity values. As a result, SI slug test data were re-analyzed. All data were analyzed by the Bouwer and Rice method (Bouwer, 1989) using the slug-test analysis computer program, BRISTA (Smith, 1995). This program is an interactive program that allows the user to visually curve-fit plotted slug test data and calculate hydraulic conductivity. All input data and program output are provided in Appendix G. Results are summarized on Table 6-6.

TABLE 6-5
SITE INSPECTION GRAIN-SIZE ANALYSIS DISTRIBUTION SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE	PERCENT PASSING				COARSE-FINE GRAVEL (75-4.7 mm)	COARSE SAND (4.7-2 mm)	MEDIUM FINE SAND (2-0.074 mm)	SILT & CLAY (< 0.074 mm)
	3-INCH SIEVE	No. 4 SIEVE	No. 10 SIEVE	No. 200 SIEVE				
MW101 S1	100	73	66	40	27	7	26	40
MW109 S1	100	71	61	29	29	10	32	29
MW100 S3	100	80	64	27	20	16	37	27
B100 S3	100	74	68	43	26	6	25	43
B101 S4	100	91	83	55	9	8	28	55
B102 S6	100	85	77	52	15	8	25	52
B103 S2	100	92	82	46	8	10	36	46
B103 S7	100	82	74	46	18	8	28	46
B104 S4	100	81	74	44	19	7	30	44
B105 S5	100	98	92	69	2	6	23	69
B106 S3	100	86	77	34	14	9	43	34
B106 S5	100	87	78	40	13	9	38	40
B107 S2	100	92	90	62	8	2	28	62
B108 S3	100	78	71	35	22	7	36	35
B110 S4	100	90	82	40	10	8	42	40
ARITHMETIC MEAN					16	8	32	44

ABBREVIATIONS

mm - millimeters

TABLE 6-6
SUMMARY OF SLUG TEST
HYDRAULIC CONDUCTIVITY DATA
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

OVERBURDEN			BEDROCK	
WELL	HYDRAULIC CONDUCTIVITY (cm/sec)	(ft/d)	WELL	HYDRAULIC CONDUCTIVITY (cm/sec) (ft/d)
MW-06	1.58E-04	0.45	MW-04	2.29E-04 0.65
MW-08	4.58E-04	1.30	MW-04 ¹	2.35E-04 0.67
MW-08 ¹	6.64E-04	1.88	MW-05	3.60E-05 0.10
MW-10	2.53E-04	0.72	MW-07	1.88E-04 0.53
MW-10 ¹	7.88E-05	0.22	MW-07 ¹	1.57E-04 0.45
MW-12	2.27E-05	0.06	MW-09	5.79E-04 1.64
MW-13	1.37E-04	0.39	MW-09 ¹	6.29E-04 1.78
JMW-107 ²	1.64E-04	0.47	MW-11	2.20E-05 0.06
JMW-108 ²	4.09E-05	0.12	SW-2 ³	3.70E-05 0.10
JMW-109 ²	1.88E-04	0.53	SW-3 ³	2.57E-05 0.07
Geometric Mean K:		0.35	Geometric Mean K: 7.84E-05 0.22	

ABBREVIATIONS

K - Hydraulic Conductivity
cm/sec - centimeters per second
ft/d - feet per day

NOTES

- ¹ Duplicate analysis performed for quality assurance purposes.
Results arithmetically averaged prior to calculation of formation geometric mean.
² Re-evaluation of E.C. Jordan SI data.
³ Results from Dames & Moore (1986).

In the overburden, hydraulic conductivity values range from 0.06 to 1.88 feet/day (ft/d) (2.27×10^{-5} to 6.64×10^{-4} cm/sec) with a geometric mean value of 0.35 ft/d (1.23×10^{-4} cm/sec). Hydraulic conductivity in wells completed in the weathered till (MW-06, MW-12 and JMW-107) ranged from 0.06 to 0.45 ft/d (2.27×10^{-5} to 1.58×10^{-4} cm/sec). All remaining overburden wells were completed in the unweathered till. The range in calculated hydraulic conductivity in these wells was 0.12 to 1.88 ft/d (4.09×10^{-5} to 6.64×10^{-4} cm/sec). In the weathered fractured shale bedrock interval, hydraulic conductivity values range from 0.06 to 1.78 ft/d (2.27×10^{-5} cm/sec to 6.29×10^{-4} cm/sec) with a geometric mean value of 0.22 ft/d (7.84×10^{-5} cm/sec).

Although hydraulic conductivity values vary throughout the study area, a comparison of geometric mean hydraulic conductivity values shows hydraulic conductivity to be only slightly higher in the overburden than bedrock. This difference is not considered significant. Vertical hydraulic conductivity values were not evaluated during this investigation, either by laboratory or field methods. However, given the nature of sediment deposition in this area, vertical hydraulic conductivity values an order or two lower than horizontal hydraulic conductivity could be expected.

6.1.2.5 Average Linear Velocity

The actual rate of groundwater movement through the subsurface is referred to as seepage velocity or average linear velocity (V). Table 6-7 summarizes the estimates of horizontal average linear velocity in both the overburden and bedrock based on an equation in Appendix F. More than one estimate is provided due to the range of estimates of effective porosity and hydraulic gradient (in the overburden).

In the overburden, horizontal average linear velocity estimates range from 0.21 to 0.64 ft/d. In the bedrock, estimates range from 0.30 to 2.42 ft/d. The relatively high horizontal average linear velocity estimates are due to both the high horizontal gradient and the relatively low formation effective porosity. If, as is expected, overburden vertical hydraulic conductivity is an order or two lower than horizontal hydraulic conductivity, vertical seepage velocity estimates would be correspondingly lower as well.

6.1.3 Surface Water Hydrology

Section 3.5 provides a general discussion of regional and local surface water hydrology. In order to further quantify local surface water hydrology six staff gages were installed during this investigation, although one was lost prior to the completion of the field survey. The remaining five gages were surveyed to the same datum as the monitoring wells. Staff gage SG-1 was located in the constructed "pond" at the northern end of Site 1. Four additional gages were installed in Murphy's Gulch and the sedimentation pond downgradient of Site 1. Staff gages were measured during the December 1995 and April 1996 measurement rounds. Elevation calculations are summarized in Table 6-3. Data from the April 1996 measurement round are posted on Figure 6-9.

TABLE 6-7
AVERAGE LINEAR VELOCITY ESTIMATES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

PARAMETER VARIED	OVERBURDEN				BEDROCK		
	K (ft/d)	i	n _e	V _x (ft/d)	K (ft/d)	i	n _e V _x (ft/d)
High n _e & High i	0.35	0.11	0.10	0.39	0.22	0.11	0.08 0.30
Low n _e & High i	0.35	0.11	0.06	0.64	0.22	0.11	0.01 2.42
High n _e & Low i	0.35	0.06	0.10	0.21			
High n _e & Low i	0.35	0.06	0.06	0.35			

ABBREVIATIONS

K - Hydraulic Conductivity
ft/d - feet per day
n_e - effective porosity
V_x - Average Linear Velocity
i - horizontal gradient

In the vicinity of Site 2, storm water flows as overland runoff to a drainage swale that runs northward, parallel to the crushed rock Patrol Road, then flows east through a culvert that passes under the crushed rock Patrol Road. This runoff then flows eastward, eventually entering Murphy's Gulch.

Flow net analysis suggests that groundwater discharges to surface water (Section 6.1.2.2) in the vicinity of the wetlands east of Site 1, which are drained by Murphy's Gulch. The actual volume of flow and discharge point to the surface probably varies seasonally as the wetlands and Murphy's Gulch have been observed to have no standing water during drier periods of the year. Water flowing to Murphy's Gulch then flows northward joining the flow originating from the vicinity of the Town of New Windsor landfill southeast of Site 1.

Table 6-3 shows that water levels at the staff gages were similar between measurement rounds, varying more than 0.5 feet only at SG-1 in the constructed "pond" and the detention pond in Murphy's Gulch (1.3 feet at SG-6). Corresponding groundwater elevation changes in selected nearby wells were also compared. Water levels in wells closest to SG-1 (MW-11 and MW-12) varied by 2.14 and 3.13 feet, respectively. Water levels in MW-05 and MW-06, closest to SG-6, varied by 1.01 and 0.44 feet, respectively. Water levels in the MW-05/06 pair, located closer to Murphy's Gulch and the wetlands, appear to track changes in the staff gages more closely than at SG-1. However, this interpretation is based on only two rounds of surface water level measurements. The limited data suggest fairly uniform flow in and to surface water bodies via groundwater discharge and overland flow. Flow is controlled in surface water bodies by berms at pond outlets.

6.2 Background Sampling Results

As discussed in Section 5.0, background samples were collected for soils and sediment. Six soil samples were collected, three each from SB-01 and MW-01. Analytical results for the background soil samples are presented in Table 6-8. Two sediment samples were collected from within the drainage swale along the crushed rock Patrol Road (SS-01 and SS-03). Analytical results for the two background sediment samples are presented in Table 6-9.

For each inorganic analyte detected in site soils and sediment, a site-specific background concentration was derived by first calculating the mean concentration value of the analyte detected in all background samples. Next, two times the standard deviation of the data set of background concentrations for the analyte was added to the mean value. This second value was then compared to the maximum concentration of the specific analyte detected in the background samples. Based on the results of this comparison, the lesser of the two values was considered to be the site-specific background concentration for that inorganic analyte. Site-specific background concentrations for inorganic analytes at Site 2 are presented in Tables 6-10 and 6-11 for soil and sediment, respectively.

TABLE 6-8
SITE 2 BACKGROUND SOIL SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	SAMPLE NUMBER											
		MW-01-04		MW-01-18		MW-01-31.6		SB-01-02		SB-01-18.5		SB-01-32.5	
VOCs (µg/kg)													
2-Butanone	10	11	U	11	U	11	U	11	U	11	U	11	U
Benzene	10	11	U	11	U	11	U	11	U	11	U	11	U
Carbon Disulfide	10	11	U	11	U	11	U	11	U	1	J	11	U
Chlorobenzene	10	11	U	11	U	11	U	11	U	11	U	11	U
Chloroform	10	11	U	11	U	11	U	11	U	11	U	11	U
Ethylbenzene	10	11	U	11	U	11	U	11	U	11	U	11	U
Methylene Chloride	10	11	U	11	U	11	U	11	U	11	U	11	U
Toluene	10	11	U	1		11	U	11	U	11	U	11	U
Total Xylenes	10	11	U	11	U	11	U	1		11	U	11	U
SVOCs (µg/kg)													
2,4-Dichlorophenol	330	360	U	360	U	370	U	360	U	360	U	360	U
2-Methylnaphthalene	330	360	U	360	U	370	U	360	U	360	U	360	U
Bis(2-ethylhexyl)phthalate	330	360	U	360	U	370	U	360	U	360	U	360	U
Di-n-butylphthalate	330	360	U	360	U	370	U	360	U	43		360	U
Fluoranthene	330	360	U	360	U	370	U	360	U	360	U	360	U
Naphthalene	330	360	U	360	U	370	U	360	U	360	U	360	U
Phenanthrene	330	360	U	360	U	370	U	360	U	360	U	360	U
Pyrene	330	360	U	360	U	370	U	360	U	360	U	360	U
PEST/PCBs (µg/kg)													
4,4'-DDD	3.3	3.6	U	3.7	U	3.7	U	3.6	U	3.6	U	3.6	U
4,4'-DDE	3.3	3.6	U	3.7	U	3.7	U	1.9		3.6	U	3.6	U
4,4'-DDT	3.3	3.6	U	3.7	U	3.7	U	2.3	J	3.6	U	3.6	U
alpha-Chlordane	1.7	1.8	U	1.8	U	1.8	U	1.8	U	1.8	U	1.8	U
gamma-Chlordane	1.7	1.8	U	1.8	U	1.8	U	1.8	U	1.8	U	1.8	U
Dieldrin	3.3	3.6	U	3.7	U	3.7	U	3.6	U	3.6	U	3.6	U
INORGANICS (mg/kg)													
Aluminum	40	9,970		10,600		11,100		10,300		11,900		9,860	
Antimony	12	9.1	U	14.6	J	9.2	U	9.1	U	9.1	U	4.6	U
Arsenic	2	6.2		5.3		4.8		4.1		3.9		3.3	
Barium	40	43.4		47.7		50.6		34.2		53.8		52.4	
Beryllium	1	0.86		0.96		0.82		0.66		0.74		0.48	
Calcium	1,000	21,800		23,100		23,400		31,600	R	22,000	R	21,300	R
Chromium	2	15	J	16.1	J	17.5		16.3		15.6		15.1	
Cobalt	10	11.8		10.6		11.6		10.7		9.7		9.2	
Copper	5	25	J	26.4	J	28	J	23.9		23.7		20.5	
Iron	20	22,400		23,900		24,800		22,100		24,000		21,400	
Lead	0.6	12.5	J	12.2	J	11.8	J	11.1		10.7		10.3	
Magnesium	1,000	6,430		7,130		7,160		5,830		7,190		5,740	
Manganese	3	524		614		623		541		568		535	
Nickel	8	23.7		24.4		24.9		20.6		23.3		21.5	
Potassium	1,000	886		870		960		919		1,420		1,040	
Silver	2	1.2	J	0.83	U	1.3	J	0.82	U	0.82	U	0.63	
Sodium	1,000	19.1		41.6		49.7		57.9	R	53.3	R	54.3	R
Thallium	2	0.55	J	0.67	J	0.48	J	1.1	J	0.56	J	0.29	J
Vanadium	10	11		12.5		13.1		12.7		14.5		12	
Zinc	4	54.8		63.2		62.7		62.3		61.7		53.3	

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
4,4'-DDE - Dichlorodiphenyldichloroethylene
4,4'-DDT - Dichlorodiphenyltrichloroethane
mg/kg - milligrams per kilogram
ND - Not Detected
PEST/PCBs - Pesticides/Polychlorinated Biphenyls
SVOCs - Semi-Volatile Organic Compounds
VOCs - Volatile Organic Compounds
µg/kg - micrograms per kilogram

DATA QUALIFIERS

J - Estimated Value
R - Rejected Value
U - Below Quantitation Limit

NOTES

1) Detection Limits - Contract Required Detection Limits for Organics
- Contract Required Quantitation Limits for Inorganics

TABLE 6-9
SITE 2 BACKGROUND SEDIMENT SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	SAMPLE NUMBER	
		SS-01	SS-03
VOCs (µg/kg)			
Total Xylenes	10	11 U	11 U
SVOCs (µg/kg)			
Benzo(a)anthracene	330	360 U	380 U
Benzo(a)pyrene	330	360 U	380 U
Benzo(b)fluoranthene	330	360 U	380 U
Benzo(k)fluoranthene	330	360 U	380 U
Benzo(g,h,i)perylene	330	360 U	380 U
Carbazole	330	360 U	380 U
Chrysene	330	360 U	380 U
Dibenz(a,h)anthracene	330	360 U	380 U
Di-n-butylphthalate	330	54	380 U
Indeno(1,2,3-cd)pyrene	330	360 U	380 U
Fluoranthene	330	360 U	51
Phenanthrene	330	360 U	380 U
Pyrene	330	360 U	39
PEST/PCBs (µg/kg)			
4,4'-DDD	3.3	3.6 U	1.4 J
4,4'-DDE	3.3	0.58 J	4.6
4,4'-DDT	3.3	0.5 J	6.5
Dieldrin	3.3	0.49 J	0.2 R
INORGANICS (mg/kg)			
Aluminum	40	12500	12100
Arsenic	2	3.6	4.4
Barium	40	45.1	42
Beryllium	1	0.51	0.84
Chromium	2	15.6	15.2
Cobalt	10	8.3	10.6
Copper	5	20.1	24.2
Iron	20	21500	23400
Lead	0.6	14.6	13.6
Magnesium	1000	5030	4570
Manganese	3	672	605
Mercury	0.1	0.04 U	0.04 U
Nickel	8	20.5	28.6
Potassium	1000	921	636
Silver	2	0.5	0.87 U
Thallium	2	0.13 J	0.14 UJ
Vanadium	10	17.5	14.3
Zinc	4	61.4	58.1

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane

4,4'-DDE - Dichlorodiphenyldichloroethylene

4,4'-DDT - Dichlorodiphenyltrichloroethane

mg/kg - milligrams per kilogram

ND - Not Detected

NYSDEC - New York State Department of Environmental Conservation

PEST/PCBs - Pesticides/Polychlorinated Byphenyls

SVOCs - Semi-Volatile Organic Compounds

VOCs - Volatile Organic Compounds

µg/kg - micrograms per kilogram

DATA QUALIFIERS

J - Estimated Value

R - Rejected Value

U - Below Detection Limit

NOTES

1) Detection Limits

- Contract Required Detection Limits for Organics

- Contract Required Quantitation Limits of Inorganics

TABLE 6-10
SITE 2 SITE-SPECIFIC BACKGROUND
INORGANIC CONCENTRATION CALCULATIONS - SOIL
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	MEAN CONC. (ppm)	STANDARD DEVIATION	MEAN CONC. + 2 x STD DEV (ppm)	MAXIMUM CONC. (ppm)	BACKGROUND CONC. (ppm)
Aluminum	10,622	704	12,029	11,900	11,900
Antimony	14.60	0.00	14.6	14.6	14.6
Arsenic	4.60	0.96	6.5	6.2	6.2
Barium	47.02	6.65	60.3	53.8	53.8
Beryllium	0.75	0.15	1.1	0.96	0.96
Calcium	22,767	694	24,156	31,600	24,156
Chromium	15.93	0.85	17.6	17.5	17.5
Cobalt	10.60	0.93	12.5	11.8	11.8
Copper	24.72	2.55	29.8	28	28
Iron	23,100	1,206	25,511	24,800	24,800
Lead	11.50	0.86	13.21	12.5	12.5
Magnesium	6,580	619	7,819	7,190	7,190
Manganese	568	39	645	623	623
Nickel	23.07	1.53	26.1	24.9	24.9
Potassium	1,016	189	1,394	1,420	1,394
Silver	1.04	0.30	1.6	1.3	1.3
Sodium	36.80	12.95	62.7	57.9	57.9
Thallium	0.51	0.13	0.8	1.1	0.8
Vanadium	12.63	1.06	14.8	14.5	14.5
Zinc	59.67	4.02	67.7	63.2	63.2

ABBREVIATIONS

ND - Not Detected

ppm - parts per million

TABLE 6-11
SITE 2 SITE-SPECIFIC BACKGROUND
INORGANIC CONCENTRATION CALCULATIONS - SEDIMENT
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	MEAN CONC. (ppm)	STANDARD DEVIATION	MEAN CONC. + 2 x STD DEV (ppm)	MAXIMUM CONC. (ppm)	BACKGROUND CONC. (ppm)
Aluminum	12,300	200	12,700	12,500	12,500
Arsenic	4	0.40	4.8	4.4	4.4
Barium	44	1.55	46.7	45.1	45.1
Beryllium	0.68	0.17	1.0	0.84	0.84
Chromium	15	0.20	15.8	15.6	15.6
Cobalt	9	1.15	12	10.6	10.6
Copper	22	2.05	26.3	24.2	24.2
Iron	22,450	950	24,350	23,400	23,400
Lead	14	0.50	15.1	14.6	14.6
Magnesium	4,800	230	5,260	5,030	5,030
Manganese	639	34	706	672	672
Mercury	ND	-	ND	ND	ND
Nickel	25	4	33	28.6	28.6
Potassium	779	143	1,064	636	636
Silver	0.5	-	0.5	0.87	0.5
Thallium	0.13	-	0.13	0.14	0.13
Vanadium	16	1.60	19.1	17.5	17.5
Zinc	60	1.65	63.1	61.4	61.4

ABBREVIATIONS

ND - Not Detected

ppm - parts per million

No site-specific background concentrations are available for groundwater. Although the sample from MW-01 was expected to provide background groundwater concentrations, hydrologic analysis (See Section 6.1.1) indicates that MW-01 appears to actually be downgradient of Site 2. This condition appears to be due to local groundwater high interpreted in the vicinity of Site 2, that causes groundwater to flow radially from that area. This interpretation is supported by groundwater analytical results from MW-01 (see Section 6.2.5). Based on these findings, monitoring well MW-01 does not appear to be located upgradient of Site 2.

6.3 Site Findings

6.3.1 Screening Results

The results of all screening performed as part of the Site 2 RI are presented in Table 6-12. A total of 72 soil samples from 12 soil borings were screened on-site using the immuno assay screening method. A discussion of the calibration and analytical procedure, as well as all calibration curves, are presented in Appendix I.

Figure 6-13 shows the location of contaminant concentration distribution cross-sections. Figures 6-14 through 6-18 are cross sectional views of the subsurface soil pesticide screening data. The figures indicate that higher pesticide concentrations are present in samples collected from soil borings SB-06, SB-07, and MW-02, located downgradient of the central portions of the PPBA. MW-03 screening data (Figures 6-14 and 6-17) show a significant decrease in extent and concentration of total pesticides.

6.3.2 Surface and Subsurface Soil Analytical Results

A total of 28 soil samples collected from 9 soil borings (including background borings), were submitted for off-site laboratory analysis. Tables 6-13 and 6-14 present summaries of the analytical results for all surface and subsurface soil samples, respectively. Figure 6-19 through 6-23 present the distribution of contaminants in cross-section.

TCL Pesticides/PCBs: Pesticides, including 4,4'-DDD, 4,4',-DDE, and 4,4'-DDT, were detected at similar concentrations in all surface soil samples, including the background surface soil and sediment samples. At sample location SB-07-02, concentrations of these compounds were approximately 2 to 3 orders of magnitude higher than that detected in other surface soil samples. All detections of pesticides in surface soils were below their respective NYSDEC Cleanup Goals.

Figures 6-19 through 6-23 show that pesticides were not detected in subsurface soil samples from either of the two soil borings located west of the PPBA. Pesticides detected in subsurface soil samples from soil borings north and south of the PPBA were at found levels in the single to double digit $\mu\text{g/kg}$ range. Subsurface soil samples from soil borings east of the PPBA generally had higher pesticide concentrations than samples from other soil borings. The only detections of pesticides above their respective NYSDEC Cleanup Goals were 4,4'-DDT at 4,300 $\mu\text{g/kg}$ in sample SB-06-26.5, and 4,4'-DDD and 4,4'-DDT in sample MW-02-17 at 8,900 $\mu\text{g/kg}$ and 9,400

TABLE 6-12
SUMMARY OF PESTICIDE SCREENING RESULTS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE I.D	DATE ANALYZED	OPTICAL DENSITY	% Bo	CONCENTRATION (ppm)
SB-01-02	10/02/95	1.36	120.4	< 0.2
SB-01-06	10/02/95	1.35	119.5	< 0.2
SB-01-10	10/02/95	1.31	116	< 0.2
SB-01-13	10/03/95	1.27	128.3	< 0.2
SB-01-18.5	10/03/95	1.56	157.5	< 0.2
SB-01-25	10/03/95	1.48	149.5	< 0.2
SB-01-27.5	10/03/95	1.48	149.5	< 0.2
SB-01-32.5	10/03/95	2.16	218	< 0.2
SB-02-02	10/05/95	1.18	151.3	< 0.2
SB-02-06	10/05/95	1.31	168	< 0.2
SB-02-10.2	10/05/95	1.36	174.4	< 0.2
SB-02-24	10/05/95	1.3	166.6	< 0.2
SB-02-02	10/06/95	1.47	107.8	< 0.2
SB-02-06	10/06/95	1.6	118.5	< 0.2
SB-02-10.2	10/06/95	1.27	94	< 0.2
SB-02-24	10/06/95	1.57	116.2	< 0.2
SB-03-1.3	10/06/95	1.44	106.6	< 0.2
SB-03-06	10/06/95	1.57	116.2	< 0.2
SB-03-10.3	10/06/95	1.69	125.1	< 0.2
SB-03-17	10/06/95	1.51	111.8	< 0.2
SB-03-22	10/06/95	1.51	111.8	< 0.2
SB-04-02	10/06/95	1.37	101.4	< 0.2
SB-04-06	10/06/95	1.63	120.7	< 0.2
SB-04-11	10/06/95	1.73	128.1	< 0.2
SB-04-16	10/06/95	1.62	120	< 0.2
SB-04-21	10/06/95	1.62	120	< 0.2
SB-05-02	10/10/95	1.21	84.6	< 0.2
SB-05-06	10/10/95	0.89	62.2	0.225
SB-05-10	10/10/95	0.97	67.8	< 0.2
SB-05-17	10/10/95	1.32	92.3	< 0.2
SB-05-22	10/10/95	1.24	86.7	< 0.2
SB-06-02	10/10/95	0.84	58.7	0.29
SB-06-06	10/12/95	1.44	94.7	<0.2
SB-06-11	10/12/95	1.61	105.9	<0.2
SB-06-16	10/12/95	1.4	92.1	<0.2

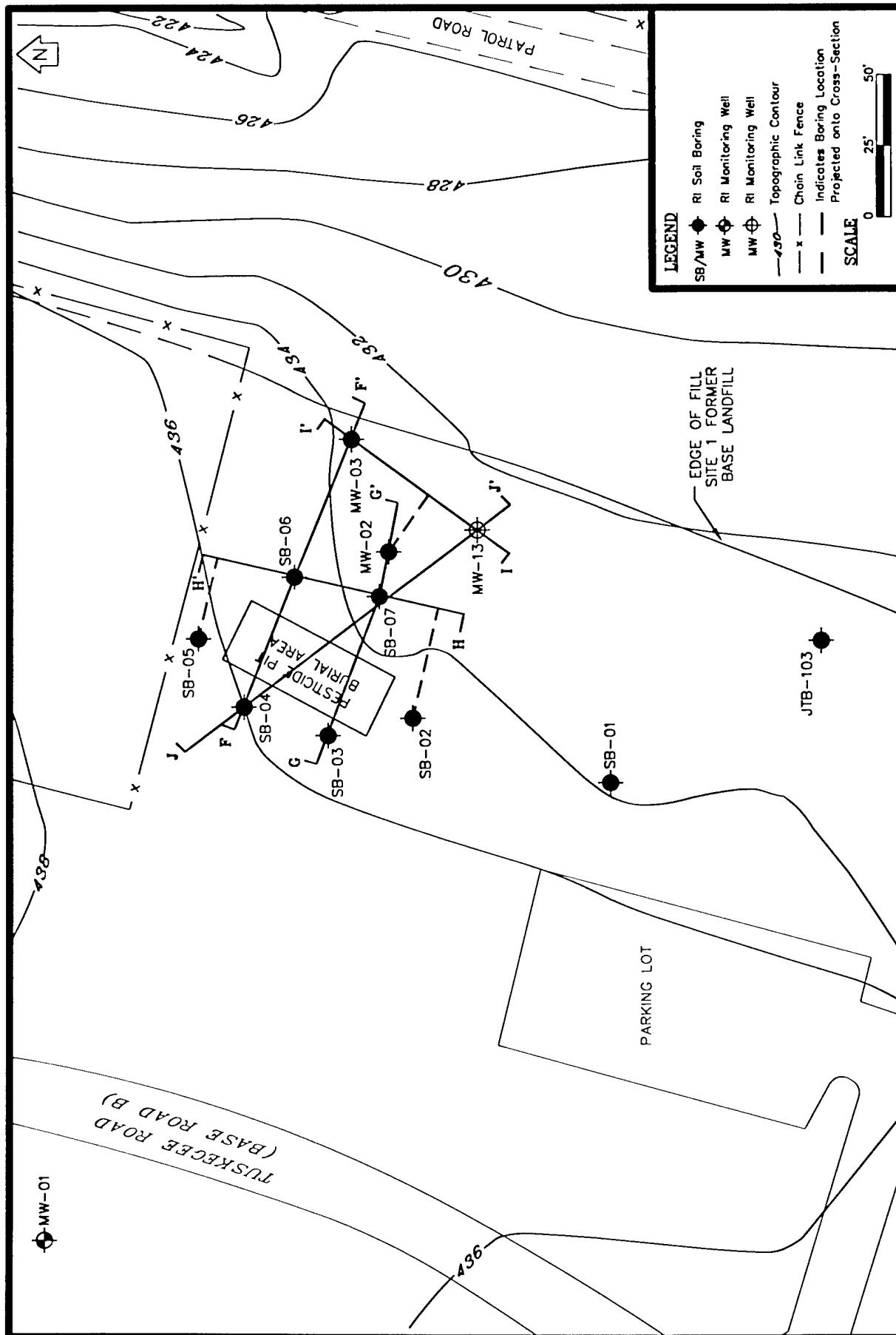
TABLE 6-12 (cont.)
RESULTS OF PESTICIDE SCREENING TESTS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

SAMPLE I.D	DATE ANALYZED	OPTICAL DENSITY	% Bo	CONCENTRATION (ppm)
SB-06-20.4	10/12/95	1.45	95.4	< 0.2
SB-06-26.5	10/12/95	0.71	46.7	8.22
SB-06-31.5	10/12/95	0.97	63.8	1.25
SB-06-34.5	10/12/95	1.55	102	< 0.2
SB-06-31.5 *	10/13/95	1.51	84.8	< 0.2
SB-07-02	10/13/95	0.72	40.4	> 10
SB-07-06	10/13/95	1.25	70.2	6.2
SB-07-11	10/13/95	1.52	85.4	< 0.2
SB-07-16	10/13/95	0.69	38.8	> 10
SB-07-25	10/13/95	1.14	64	1.35
SB-07-33	10/13/95	1.24	69.7	0.73
MW-01-04	10/17/95	0.89	81	0.25
MW-01-10	10/17/95	0.97	88.2	< 0.2
MW-01-18	10/17/95	0.94	85.5	< 0.2
MW-01-22	10/17/95	0.98	89	< 0.2
MW-01-27	10/17/95	0.97	88.2	< 0.2
MW-01-31.6	10/17/95	0.93	84.5	< 0.2
MW-02-04	10/19/95	0.82	61.7	6.45
MW-02-10	10/19/95	1.21	91	< 0.2
MW-02-15	10/19/95	0.12	9	> 10
MW-02-17	10/19/95	0.15	11.3	> 10
MW-02-22	10/20/95	0.32	20	> 10
MW-02-27	10/20/95	0.65	40.6	> 10
MW-02-31	10/20/95	1.08	67.5	0.305
MW-03-02	10/20/95	1.23	76.9	< 0.2
MW-03-06	10/20/95	1.14	71.2	0.205
MW-03-10	10/20/95	1.29	80.6	< 0.2
MW-03-16	10/20/95	1.26	78.7	< 0.2
MW-03-18	10/20/95	1.42	88.7	< 0.2
MW-03-22	10/23/95	0.82	66.7	2.13
MW-03-27	10/23/95	1.06	86.2	< 0.2
MW-03-32	10/23/95	1.11	90.2	< 0.2
SB-08-02	11/06/95	0.49	40.8	> 10
SB-08-06	11/06/95	0.91	75.8	< 0.2
SB-08-11	11/06/95	0.9	75	< 0.2
SB-08-14.5	11/06/95	0.88	73.3	< 0.2

TABLE 6-12 (cont.)
RESULTS OF PESTICIDE SCREENING TESTS
STEWART AIR NATIONAL GUARD BASE

SAMPLE I.D	DATE ANALYZED	OPTICAL DENSITY	% Bo	CONCENTRATION (ppm)
SB-08-16.4	11/06/95	0.94	78.3	< 0.2
SB-08-21	11/06/95	1.04	86.7	< 0.2
MW-09-02	11/06/95	0.92	76.7	< 0.2
MW-09-05	11/06/95	0.79	65.8	0.42
MW-09-10	11/06/95	0.97	80.8	< 0.2
MW-09-14.8	11/06/95	0.95	79.2	< 0.2

* note - sample SB-06-31.5 re-screened on 10/13/95
due to insufficient amount of sample extract as a result
of spillage on 10/12/95.



STEWART AIR NATIONAL GUARD BASE
SUBSURFACE SOIL CONTAMINANT DISTRIBUTION
CROSS SECTION LOCUS MAP

NEWBURGH, NEW YORK

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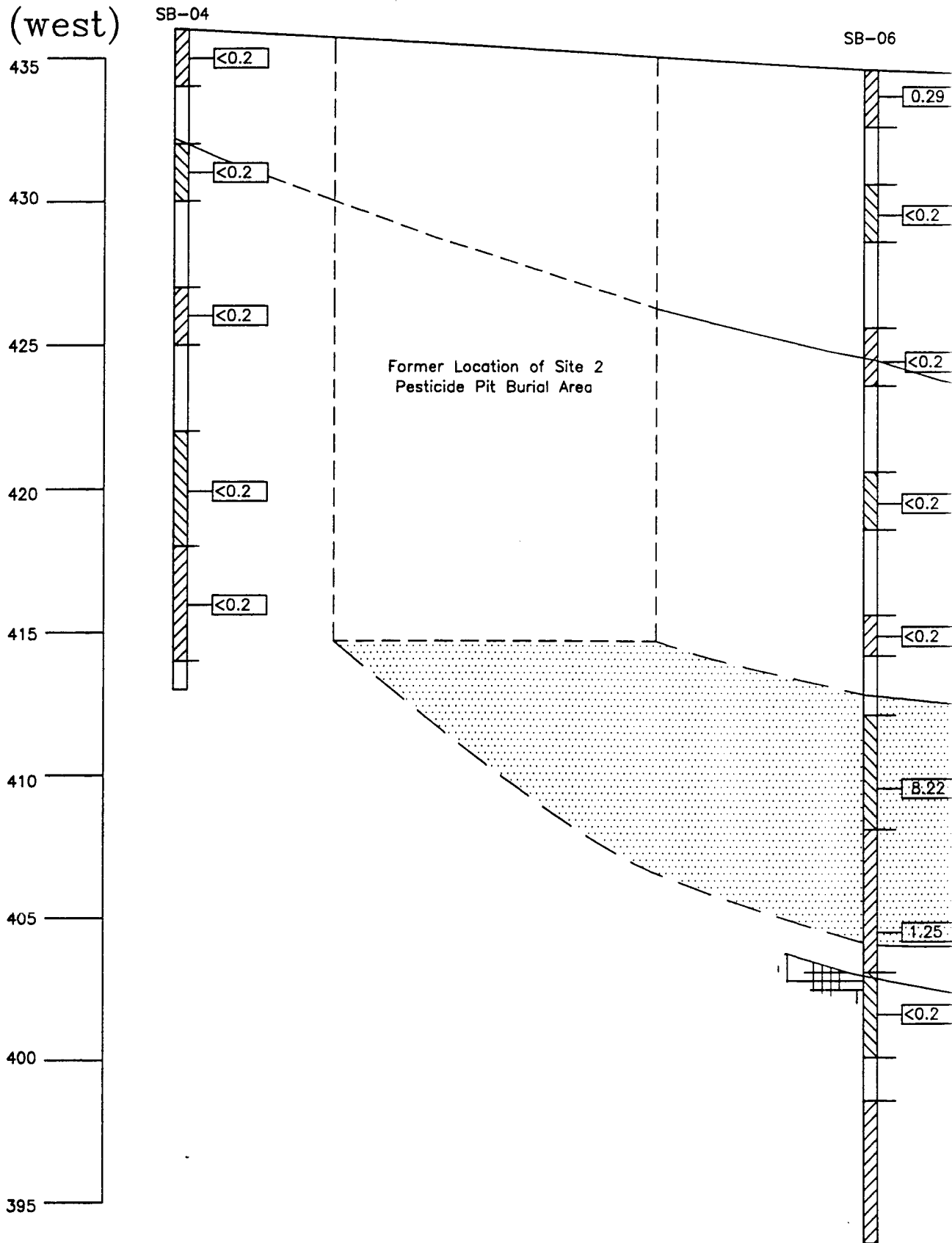
FIGURE: 6-13

Last Revision Date: 3/18/97

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F (west)

ELEVATION (FEET ABOVE MEAN SEA LEVEL)

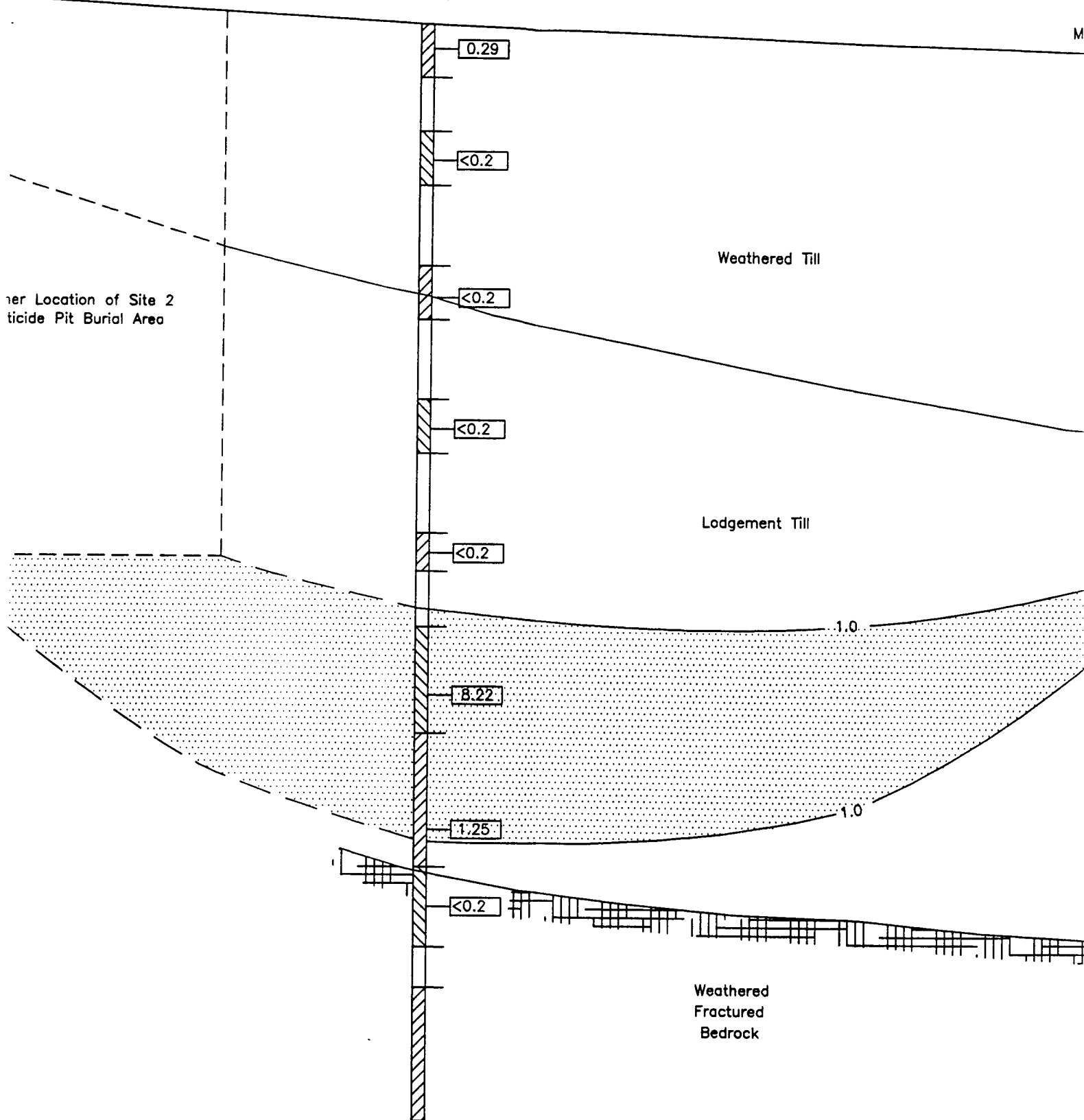


STEWART AIR NATIONAL
PESTICIDE SCREENING
CONTAMINANT DISTRIBUTION CR

NEWBURGH, NEW Y

SB-06

M

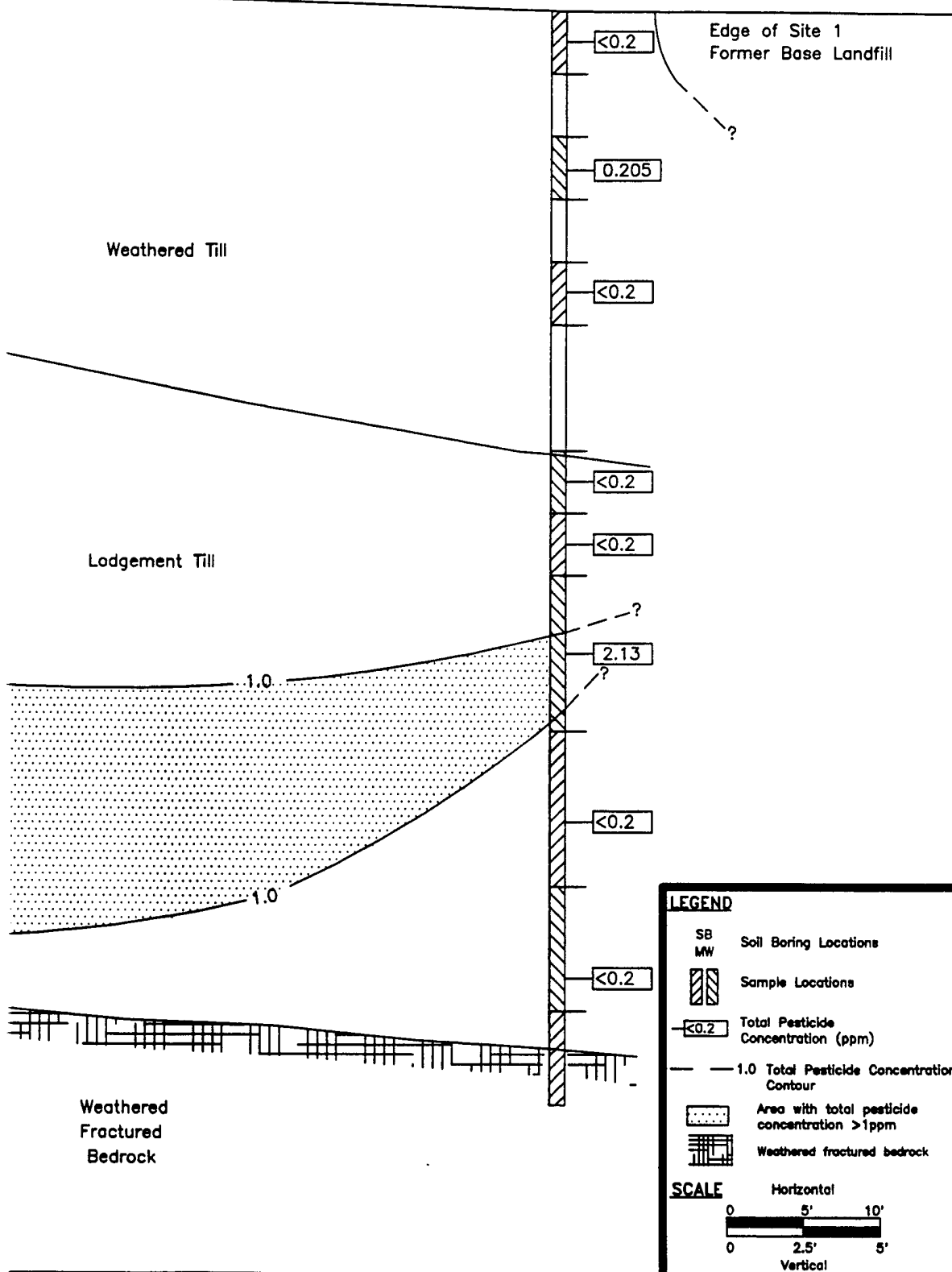


STEWART AIR NATIONAL GUARD BASE
PESTICIDE SCREENING RESULTS
CONTAMINANT DISTRIBUTION CROSS SECTION F - F'

NEWBURGH, NEW YORK

F' (east)

MW-03



BASE

F - F'

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FIGURE: 6-14

Last Revision Date: 3/18/97

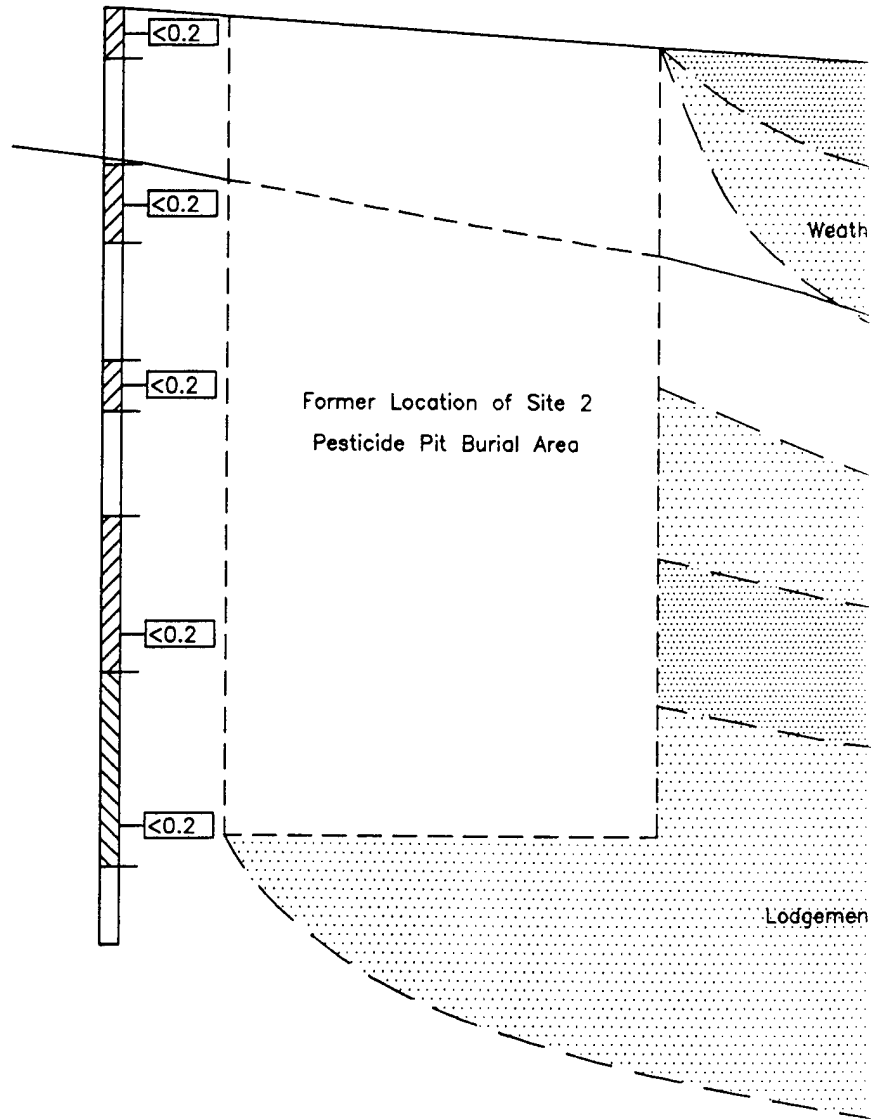
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ELEVATION (FEET ABOVE MEAN SEA LEVEL)

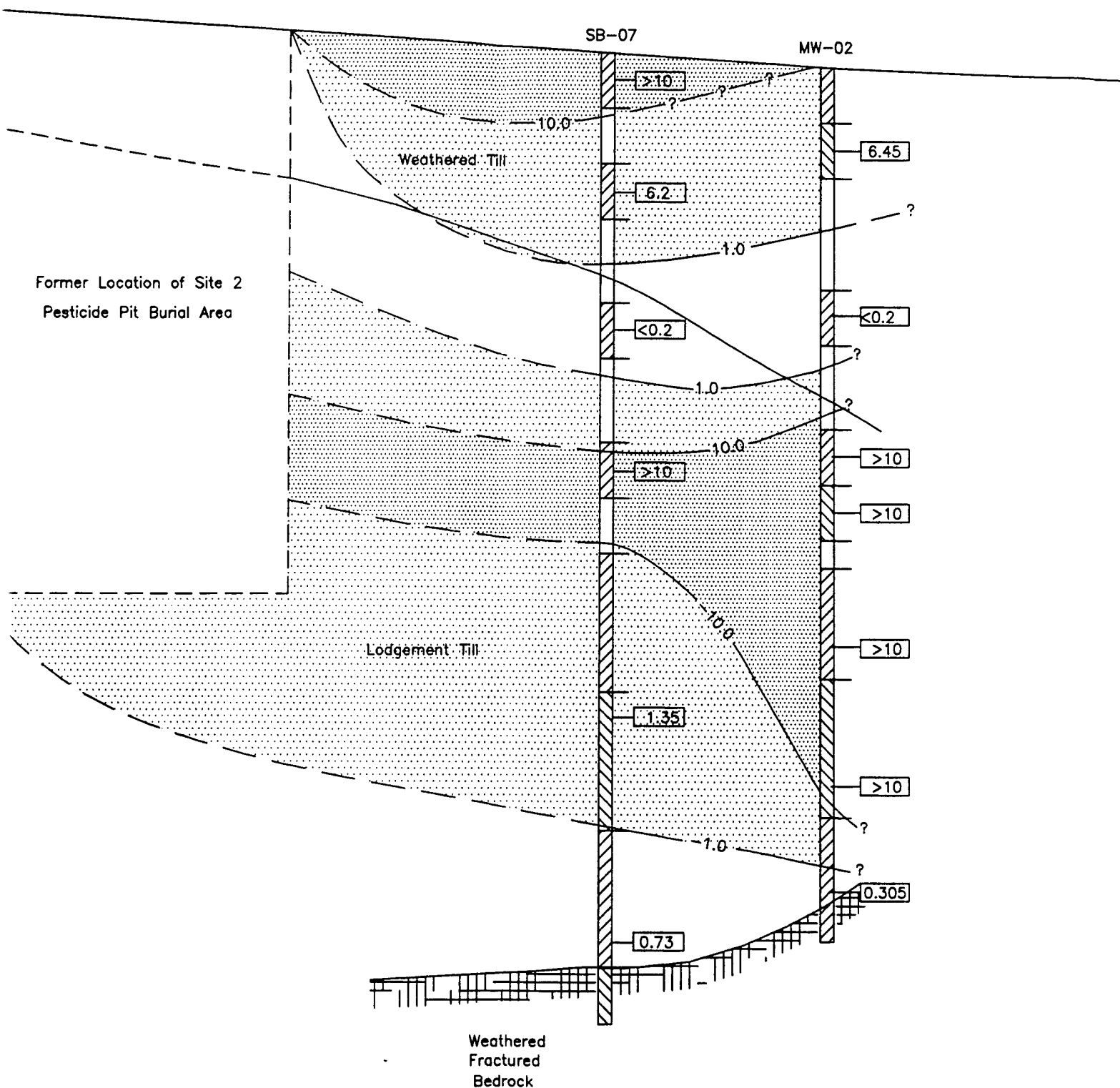
435
430
425
420
415
410
405
400
395

G (west)

SB-03



STEWART AIR NATION
PESTICIDE SCREENING
CONTAMINANT DISTRIBUTION
NEWBURGH, NEW YORK



STEWART AIR NATIONAL GUARD BASE

PESTICIDE SCREENING RESULTS

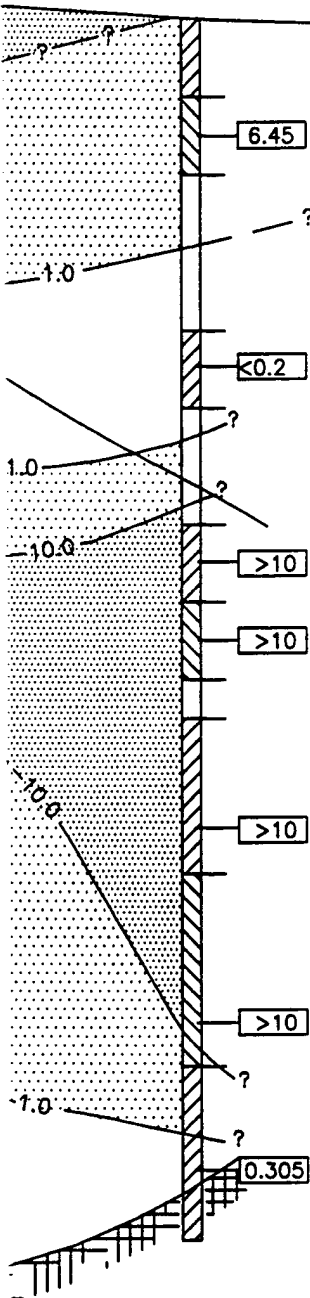
CONTAMINANT DISTRIBUTION CROSS SECTION G - G'

NEWBURGH, NEW YORK

G' (east)

MW-02

Edge of Fill
Site 1 Former
Base Landfill



LEGEND

SB
MW

Soil Boring Locations



Sample Location



Total Pesticide
Concentration (ppm)



10.0 Total Pesticide
Concentration Contour



Area with total pesticide
concentration >10ppm



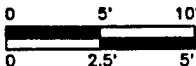
Area with total pesticide
concentration >1ppm



Weathered fractured bedrock

SCALE

Horizontal



Vertical



**ANEPTek
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G'

FIGURE: 6-15

C:\ACDWGS\ANG\STEWART\RI\SECTH_PR.DWG

Last Revision Date: 3/18/97

ELEVATION (FEET ABOVE MEAN SEA LEVEL)

435
430
425
420
415
410
405
400
395

H (west)

SB-02

SB-07

<0.2

<0.2

<0.2

<0.2

>10

6.20

<0.2

>10

1.35

0.73

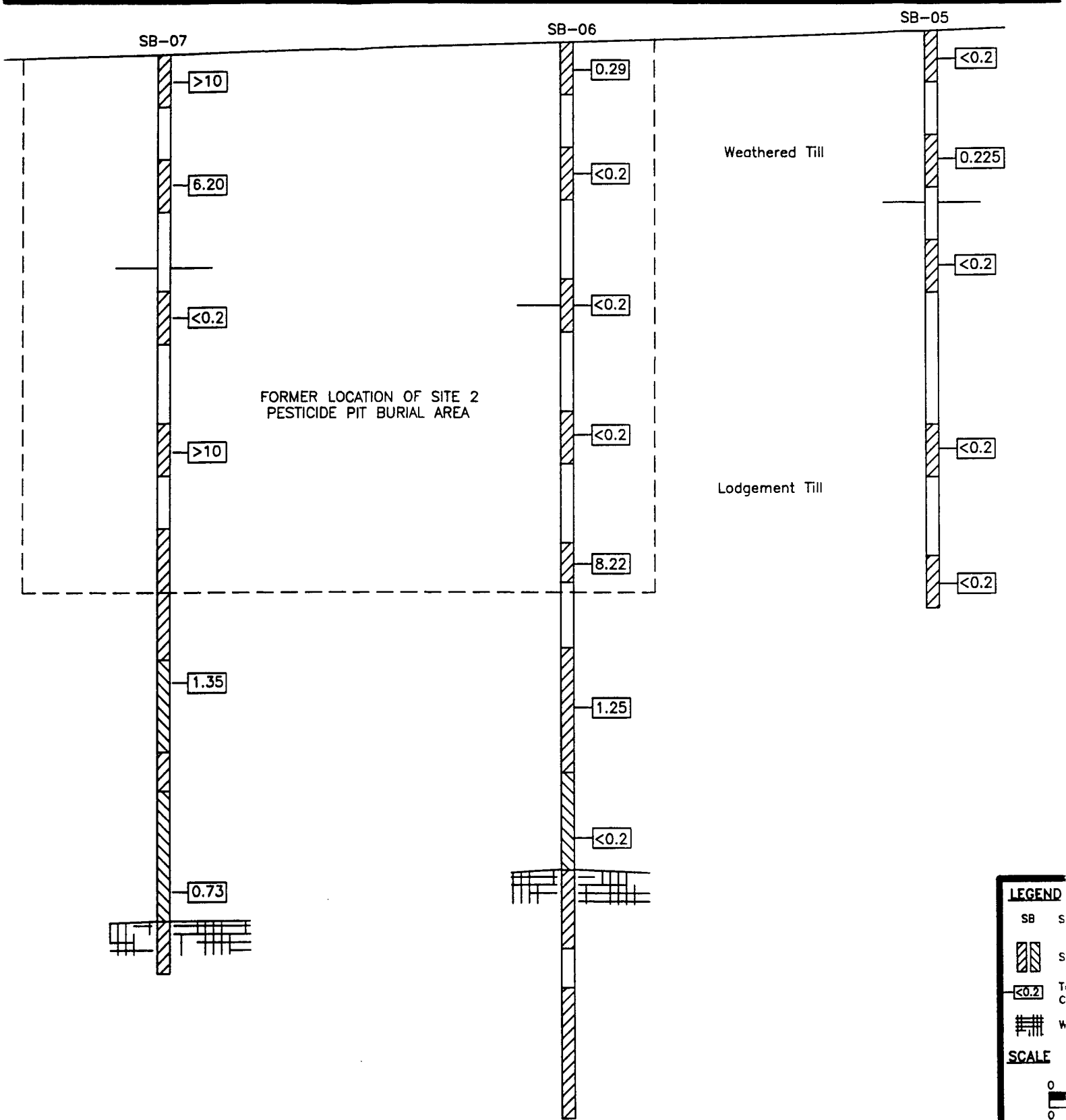
FORMER
PESTIC

STEWART AIR NATION

PESTICIDE SCREEN
PROJECTED CONTAMINANT DISTRIB

NEWBURGH, N

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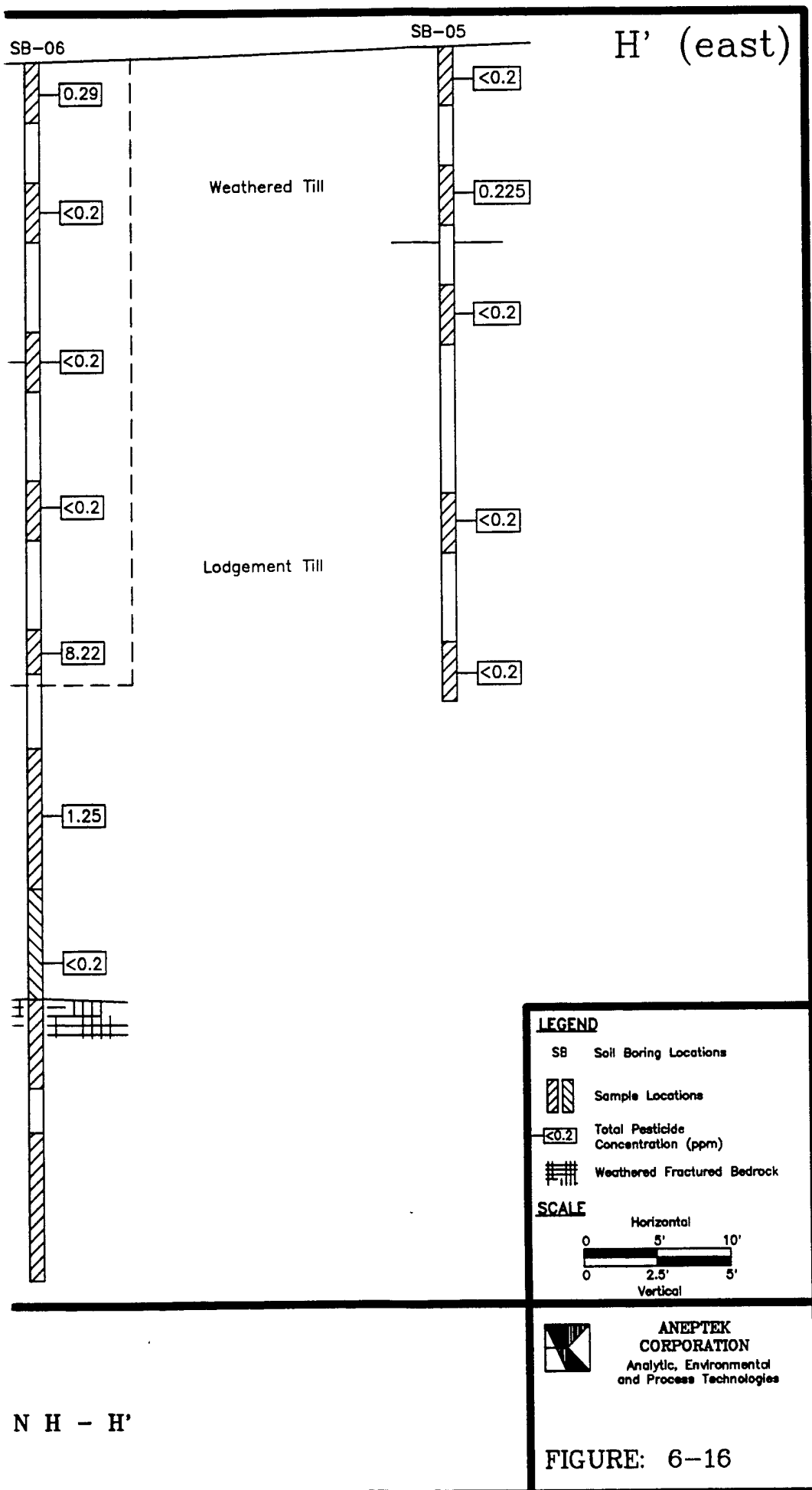
STEWART AIR NATIONAL GUARD BASE

PESTICIDE SCREENING RESULTS

ECTED CONTAMINANT DISTRIBUTION CROSS SECTION H - H'

NEWBURGH, NEW YORK

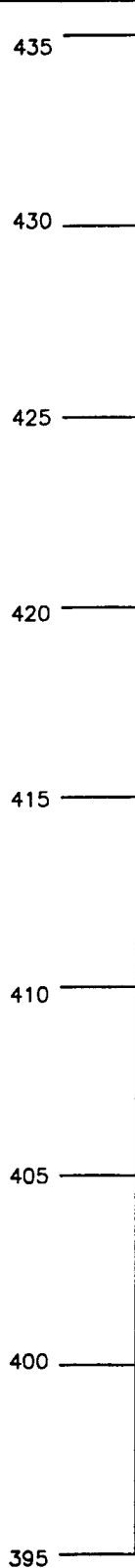
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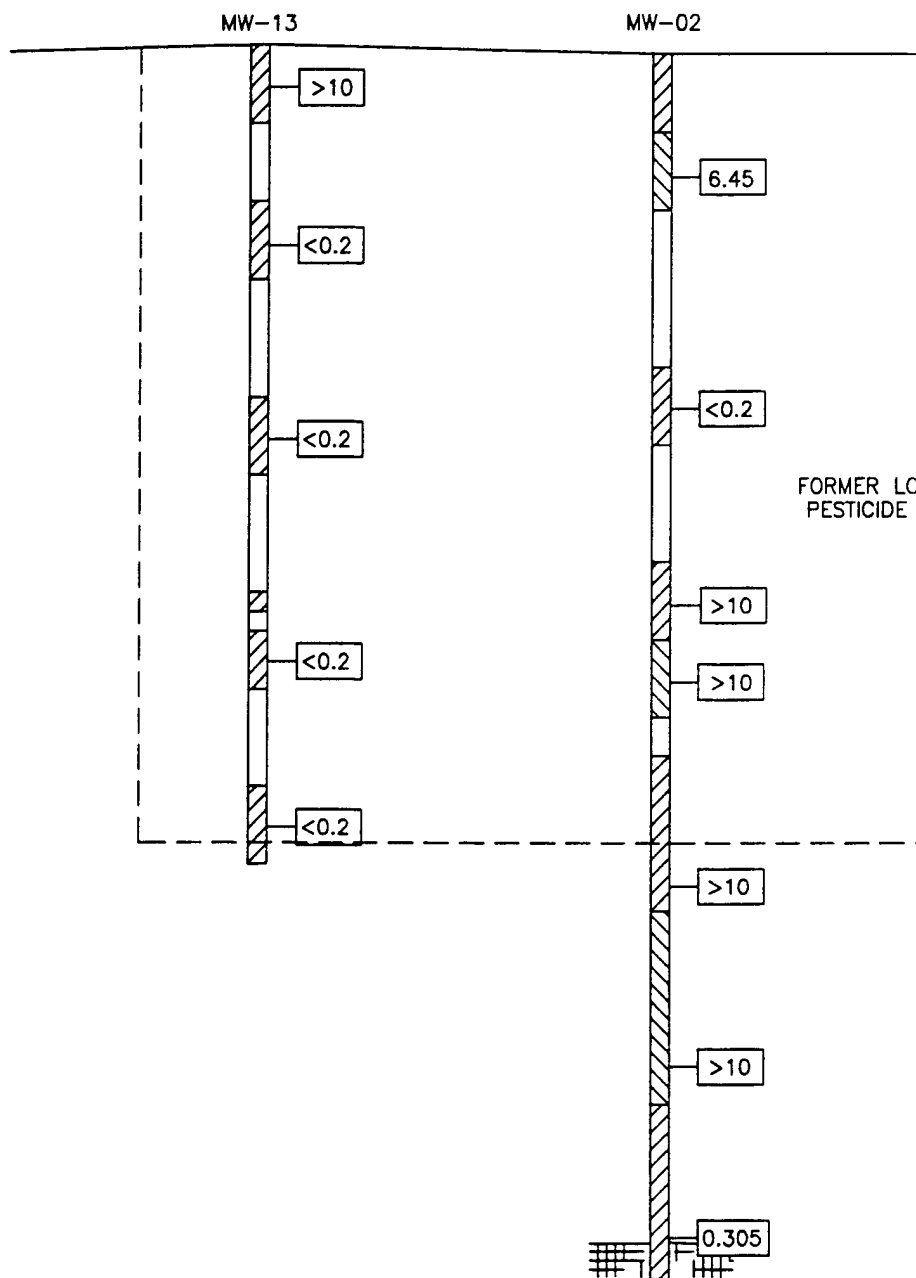
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Last Revision Date: 3/18/97

ELEVATION (FEET ABOVE MEAN SEA LEVEL)



I (west)



STEWART AIR NATION

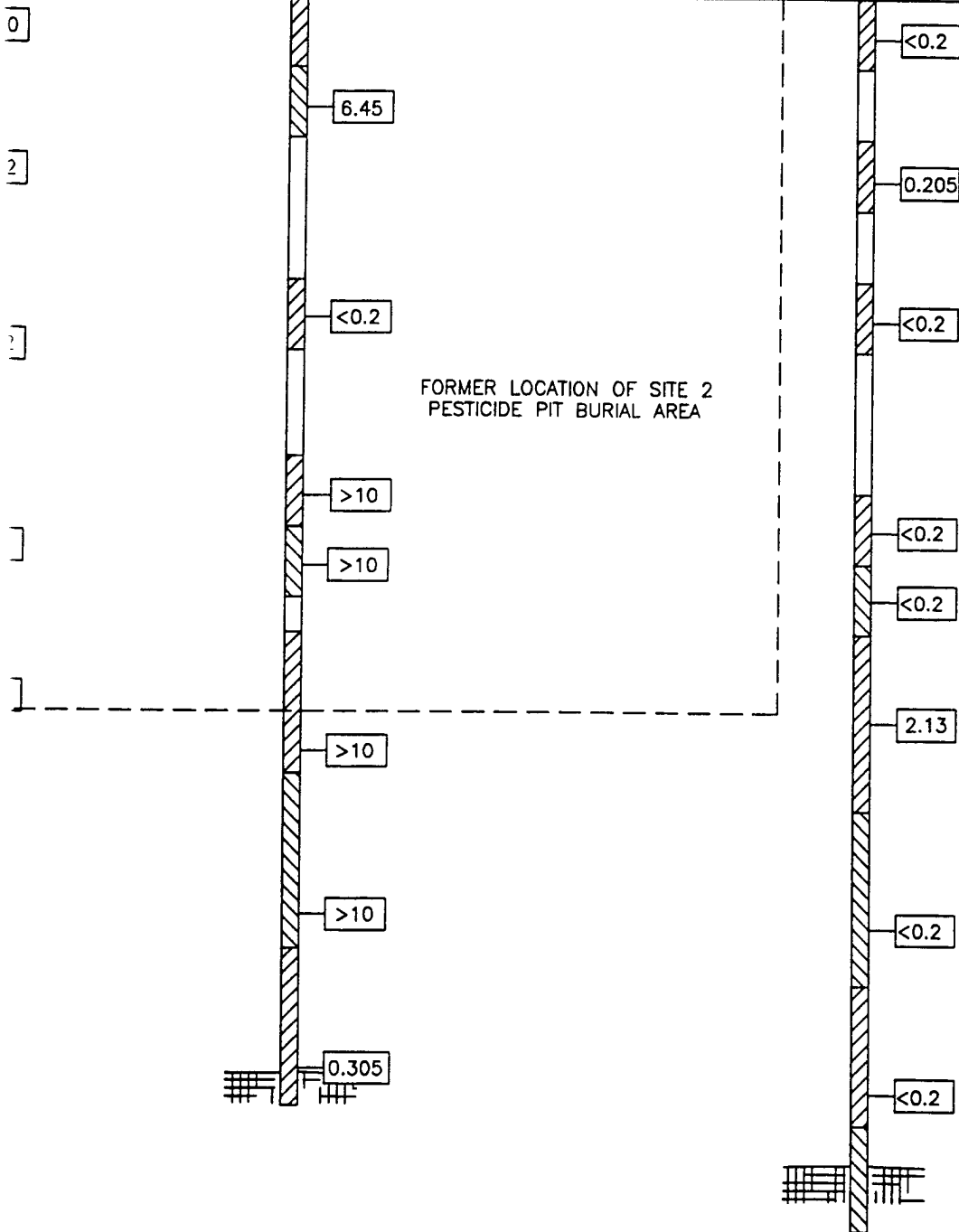
PESTICIDE SCREENING
PROJECTED CONTAMINANT DISTRIBUTION

NEWBURGH, NEW YORK

I' (east)

MW-02

MW-03



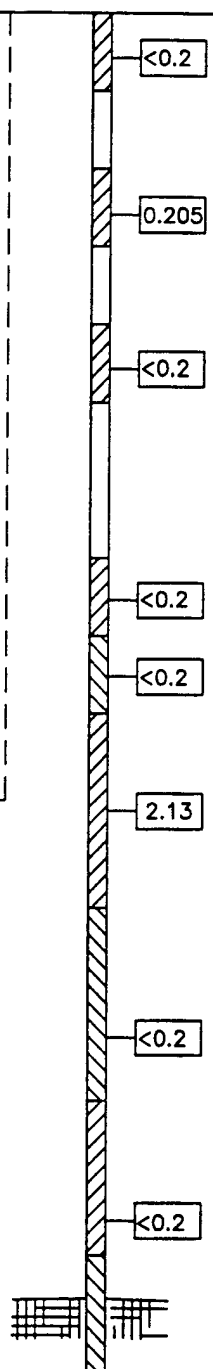
STEWART AIR NATIONAL GUARD BASE

PESTICIDE SCREENING RESULTS
PROJECTED CONTAMINANT DISTRIBUTION CROSS SECTION I - I'




NEWBURGH, NEW YORK

I' (east)

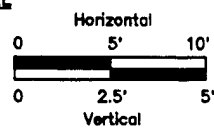
MW-03



LEGEND

- MW Soil Boring Locations
-  Sample Location
-  Total Pesticide Concentration (ppm)
-  Weathered Fractured Bedrock

SCALE



3E

SECTION I - I'

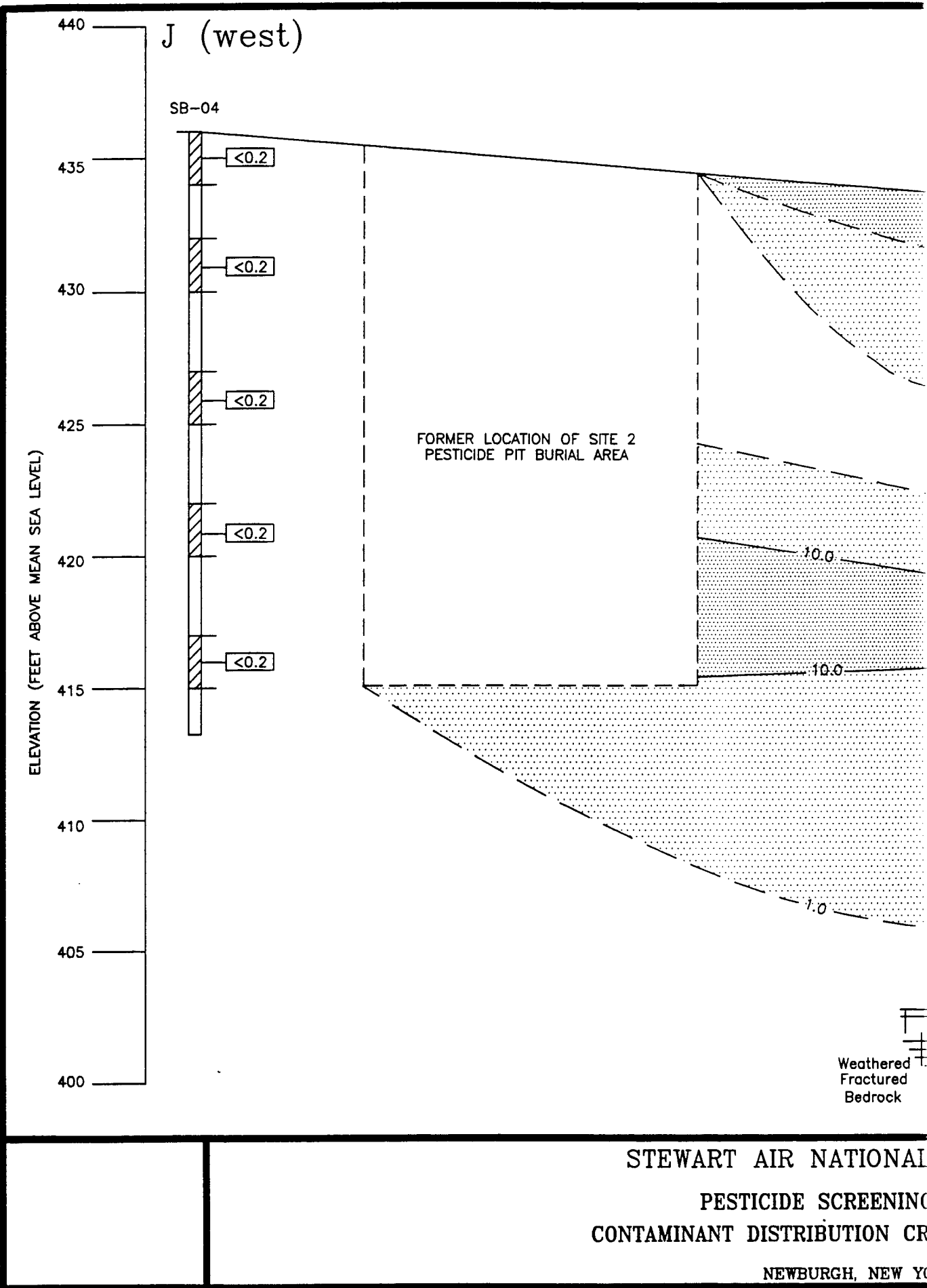


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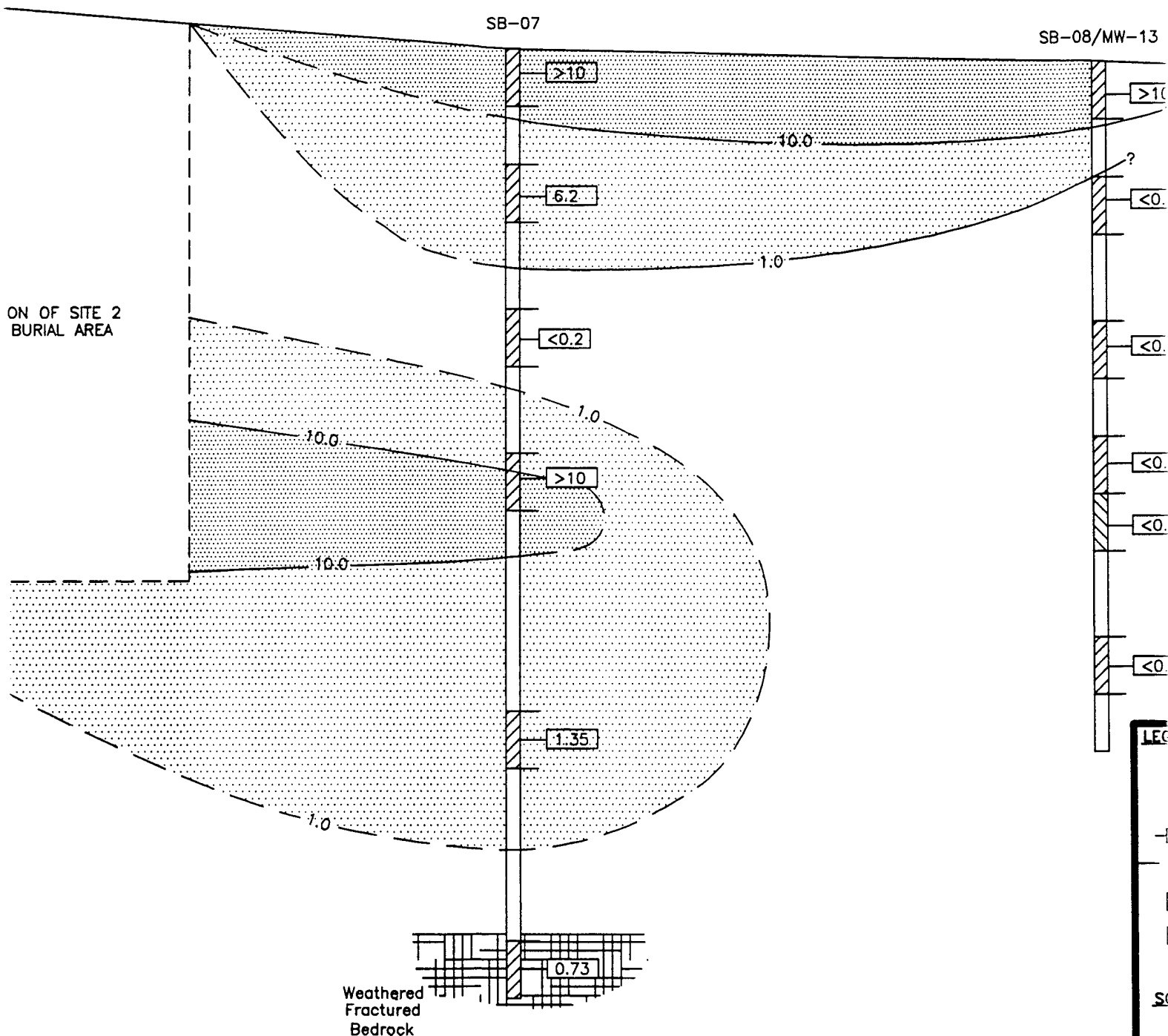
FIGURE: 6-17

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Last Revision Date: 3/18/97



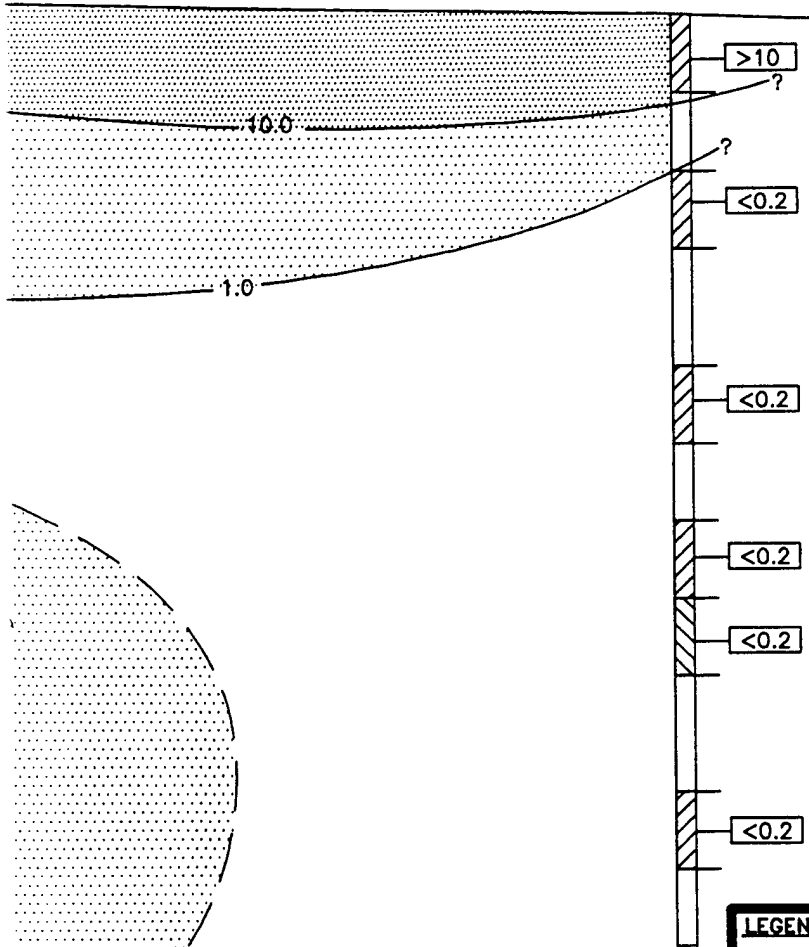
J' (east)



STEWART AIR NATIONAL GUARD BASE
PESTICIDE SCREENING RESULTS
CONTAMINANT DISTRIBUTION CROSS-SECTION J - J'
NEWBURGH, NEW YORK

J' (east)

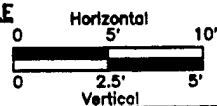
SB-08/MW-13



LEGEND

- SB
MW Soil Boring Locations
- Sample Location
- Total Pesticide Concentration (ppm)
- 10.0 Total Pesticide Concentration Contour
- Area with total pesticide concentration >10ppm
- Area with total pesticide concentration >1ppm
- Weathered fractured bedrock

SCALE



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FIGURE: 6-18

TABLE 6-13
SITE 2 SURFACE SOIL SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	SITE 2 BKGRND. CONC.	NYSDEC CLEANUP CONC.	SAMPLE NUMBER					
				SB-02-02	SB-03-1.3	SB-04-02	SB-05-02	SB-06-02	SB-07-02
VOCs (µg/kg)									
2-Butanone	10	NA	160	U	U	U	U	U	U
Benzene	10	NA	40	U	U	U	U	U	U
Carbon Disulfide	10	NA	1,940	U	U	U	U	U	U
Chlorobenzene	10	NA	1,190	U	U	U	U	U	U
Chloroform	10	NA	160	U	U	U	U	U	U
Ethylbenzene	10	NA	3,960	U	U	U	U	U	U
Methylene Chloride	10	NA	80	U	U	U	U	U	U
Toluene	10	NA	1,080	U	U	U	U	U	U
Total Xylenes	10	NA	860	1	2	U	U	3	3
SVOCs (µg/kg)									
2,4-Dichlorophenol	330	NA	270	U	U	U	U	U	U
2-Methylnaphthalene	330	NA	26,170	U	U	U	U	U	U
Di-n-butylphthalate	330	NA	5,830	U	R	U	U	U	U
Fluoranthene	330	NA	50,000	U	U	U	U	U	U
Naphthalene	330	NA	9,360	U	U	U	U	U	U
Pyrene	330	NA	50,000	U	U	U	U	U	U
PEST/PCBs (µg/kg)									
4,4'-DDD	3.3	NA	2,900	2	1.5	J	0.75	0.41	J
4,4'-DDE	3.3	NA	2,100	18	3.4	5.1	1.5	0.15	J
4,4'-DDT	3.3	NA	1,750	3.7	8.1	15	3.7	3.6	J
alpha-Chlordane	1.7	NA	540	1.9	U	U	1.8	U	R
gamma-Chlordane	1.7	NA	540	1.9	U	U	1.8	U	U
Dieldrin	3.3	NA	40	3.7	0.67	9.1	0.32	3.6	J
INORGANICS (mg/kg)									
Aluminum	40	11,900	SB	6,860	9,400	8,820	8,220	9,770	9,520
Antimony	12	14.6	SB	7.7	4.7	5.5	4.6	9.1	4.6
Arsenic	2	6.2	7.5 or SB	3.6	3.8	4	4.2	5.2	4.4
Barium	40	53.8	300 or SB	27.1	29.1	34.1	33.3	37.3	42.2
Beryllium	1	0.96	0.16 or SB	0.43	0.55	0.56	0.25	0.47	0.24
Chromium	2	17.5	10 or SB	10.2	12.3	12	12	19.7	13.7
Cobalt	10	11.8	30 or SB	7.4	9	8.7	8.4	11.7	8.8
Copper	5	28	25 or SB	18.8	22.4	21	19.7	24.9	20.9
Iron	20	24,800	2,000 or SB	16,800	20,400	20,000	19,400	22,600	21,000
Lead	0.6	12.5	SB	10	10.2	14.1	10.2	12.5	13.9
Magnesium	1,000	7,190	SB	4,110	5,030	5,060	4,830	5,150	4,510
Manganese	3	623	SB	481	592	664	652	1,070	895
Nickel	8	24.9	13 or SB	16.1	16.1	18.5	17	22.6	19
Potassium	1,000	1,394	SB	593	651	744	761	777	668
Silver	2	1.3	SB	0.67	0.71	0.6	1.1	1.1	0.42
Thallium	2	1.1	SB	0.4	0.16	0.14	0.34	0.14	0.14
Vanadium	10	14.5	150 or SB	9.7	12.6	12.2	11	12.9	12.7
Zinc	4	63.2	20 or SB	48.3	55.1	54.1	53.5	61.9	57.5

ABBREVIATIONS
 4,4'-DDD - Dichlorodiphenyldichloroethane
 4,4'-DDE - Dichlorodiphenyldichloroethylene
 4,4'-DDT - Dichlorodiphenyltrichloroethane
 mg/kg - milligrams per kilogram
 ND - Not Detected
 NYSDEC - New York State Department of Environmental Conservation
 PEST/PCBs - Pesticides/Polychlorinated Biphenyls
 SVOCs - Semi-Volatile Organic Compounds
 VOCs - Volatile Organic Compounds
 µg/kg - micrograms per kilogram

DATA QUALIFIERS
 J - Estimated Value
 R - Rejected Value

NOTES
 1) Detection Limit - Contract Required Detection Limits for Organics
 - Contract Required Quantitation Limits for Inorganics
 895 - Indicates concentration that exceeds either site-specific background concentration or NYSDEC Clean-Up Goal

TABLE 6-14
SITE 2 SUBSURFACE SOIL SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION ¹ LIMITS	SITE 2 BKGRND. CONC.	NYSD&C CLEANUP CONC.	SR-02-06	SR-02-10-2	SR-01-06	SAMPLE NUMBER			SR-03-22	SR-04-06	SR-04-21
VOCs (µg/kg)												
2-Butanone	10	NA	160	11	U	U	U	11	U	11	U	U
Benzene	10	NA	40	11	U	U	U	11	U	11	U	2
Carbon Disulfide	10	NA	1,940	2	J	J	J	2	J	11	U	J
Chlorobenzene	10	NA	1,190	11	U	U	U	11	U	11	U	U
Chloroform	10	NA	160	11	U	U	U	11	U	11	U	U
Ethylbenzene	10	NA	3,960	11	U	U	U	11	U	11	U	U
Methylene Chloride	10	NA	80	11	U	U	U	11	U	11	U	U
Toluene	10	NA	1,080	11	U	U	U	11	U	11	U	J
Total Xylenes	10	NA	860	11	U	U	U	11	U	2	U	U
SVOCs (µg/kg)												
2,4-Dichlorophenol	330	NA	270	370	U	U	U	370	U	370	U	U
2-Methylthiophenol	330	NA	26,170	370	U	U	U	370	U	370	U	U
Bis(2-ethylhexyl)phthalate	330	NA	50,000	370	U	U	U	370	U	370	U	U
Di-n-butylphthalate	330	NA	5,830	370	U	U	U	370	U	370	U	U
Fluoranthene	330	NA	50,000	370	U	U	U	370	U	370	U	U
Naphthalene	330	NA	9,360	370	U	U	U	370	U	370	U	U
Phenanthrene	330	NA	50,000	370	U	U	U	370	U	370	U	U
Pyrene	330	NA	50,000	370	U	U	U	370	U	370	U	U
PEST/PCBs (µg/kg)												
4,4'-DDD	3.3	NA	2,900	1.1	J	J	U	3.7	U	3.7	U	U
4,4'-DDE	3.3	NA	2,100	2.3	J	J	U	0.41	J	3.7	U	U
4,4'-DDT	3.3	NA	1,750	3.6	J	J	U	3.7	U	3.7	U	U
alpha-Chlordane	1.7	NA	540	1.8	U	U	U	1.9	U	1.8	U	U
gamma-Chlordane	1.7	NA	540	1.8	U	U	U	1.9	U	1.8	U	U
Dieldrin	3.3	NA	40	0.2	U	U	U	3.7	U	3.7	U	U
INORGANICS (mg/kg)												
Aluminum	40	11,900	SB	8,380	7,280	9,050	J	9,100	J	10,400	6,200	11,200
Antimony	12	14.6	SB	4.7	8	7.6	J	6.2	J	7.7	6.1	9.3
Arsenic	2	6.2	7.5 or SB	3.4	0.54	3	U	3.4	J	4.3	0.55	4.2
Barium	40	53.8	300 or SB	30.9	28.1	31.1	U	32.6	J	48.5	18.2	51.1
Beryllium	1	0.96	0.16 or SB	0.42	0.44	0.49	U	0.52	J	0.65	0.41	0.8
Calcium	1000	23,400	SB	12.2	26,400	27,400	R	27,300	R	35,000	21,700	25,800
Chromium	2	17.5	10 or SB	12.2	10.4	13.4	U	11.9	J	14.3	8.7	16.3
Cobalt	10	11.8	30 or SB	8.1	7.3	8.7	U	9.1	J	9.7	6.4	9.5
Copper	5	28	25 or SB	19.5	19.4	21.5	J	21	J	22.4	19.5	26.7
Iron	20	24,800	2,000 or SB	19,300	17,500	20,800	R	20,900	R	22,200	15,300	23,600
Lead	0.6	12.5	SB	9.7	0.17	8.1	U	10.3	R	10.9	1.7	13.9
Magnesium	1000	7,190	SB	5,920	5,710	6,500	U	6,400	R	6,670	3,660	6,970
Manganese	3	623	SB	541	534	520	U	508	J	542	392	642
Nickel	8	24.9	13 or SB	17.2	15.4	17.6	U	18.8	J	21.3	14.4	23.9
Potassium	1000	1,304	SB	779	671	886	U	883	J	1,060	530	1,290
Silver	2	1.3	SB	0.69	0.83	0.77	U	0.92	R	0.63	0.91	1.2
Sodium	1000	49.7	SB	40.2	37.6	43.9	R	43.7	R	48.1	42.7	30.1
Thallium	2	1.1	SB	0.19	0.13	0.22	U	0.18	J	0.26	0.13	0.13
Vanadium	10	14.5	150 or SB	10	9.5	12.1	J	12.2	J	13.5	8.7	14.7
Zinc	4	63.2	20 or SB	46	40.8	54	U	55.5	J	56.6	42.9	58.9

TABLE 6-14 (cont.)
SITE 2 SUBSURFACE SOIL SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION ¹ LIMITS	SITE 2 BKGRND. CONC.	NYSDEC CLEANUP CONC.	SAMPLE NUMBER						
				SB-05-06	SB-05-22	SB-06-26.5	SB-06-34.5	SB-07-16	SB-07-33	SB-17-33
VOCs (ug/kg)										
2-Butanone	10	NA	160	11	U	22	12	3	11	11
Benzene	10	NA	40	11	U	22	12	7	11	11
Carbon Disulfide	10	NA	1,940	11	U	22	12	1	11	11
Chlorobenzene	10	NA	1,190	11	U	22	12	11	11	11
Chloroform	10	NA	160	11	U	22	2	U	11	11
Ethylbenzene	10	NA	3,960	11	U	17	12	U	11	11
Methylene Chloride	10	NA	80	2	U	22	1	1	1	1
Toluene	10	NA	1,080	11	U	22	12	1	1	2
Total Xylenes	10	NA	860	11	U	22	12	2	11	11
SVOCs (ug/kg)										
2,4-Dichlorophenol	330	NA	270	370	U	360	390	370	360	360
2-Methylnaphthalene	330	NA	26,170	370	U	2,300	390	100	360	360
Bis(2-ethylhexyl)phthalate	330	NA	50,000	370	U	360	390	U	360	360
Di-n-butylphthalate	330	NA	5,830	370	U	360	390	2300	360	360
Fluoranthene	330	NA	50,000	370	U	360	390	370	360	360
Naphthalene	330	NA	9,360	370	U	1,500	390	590	360	360
Phenanthrene	330	NA	50,000	370	U	360	390	370	360	360
Pyrene	330	NA	50,000	370	U	360	390	370	360	360
PEST/PCBs (ug/kg)										
4,4'-DDD	3.3	NA	2,900	44	19	890	9.9	11	57	69
4,4'-DDE	3.3	NA	2,100	3.5	35	43	0.64	8.4	1.5	1.4
4,4'-DDT	3.3	NA	1,750	18	49	4,300	19	48	69	58
alpha-Chlordane	1.7	NA	540	1.8	U	4.4	1.9	1.8	1.8	1.8
gamma-Chlordane	1.7	NA	540	1.8	U	2.9	1.9	1.8	1.8	1.8
Dieldrin	3.3	NA	40	11	7	7.2	3.9	3.7	3.6	3.6
INORGANICS (mg/kg)										
Aluminum	40	11,900	SB	10,500	9,330	10,300	15,600	8,590	10,500	9,360
Antimony	12	14.6	SB	9.2	4.7	4.6	9.8	4.6	4.6	4.6
Arsenic	2	6.2	7.5 or SB	2.6	5	3.1	6.4	3.9	4	4
Barium	40	53.8	300 or SB	53.8	59.2	47.3	63.1	33	49.9	51.5
Beryllium	1	0.96	0.16 or SB	0.59	0.24	0.31	0.69	0.32	0.44	0.4
Calcium	1,000	23,400	SB	25,800	24,600	21,800	2,630	28,300	21,400	21,700
Chromium	2	17.5	10 or SB	17.2	15.2	16.3	27.5	14.8	15	13.8
Cobalt	10	11.8	30 or SB	12.9	10	9.4	16.1	7.6	10.1	9
Copper	5	28	25 or SB	26.6	23.7	20.3	36.8	19.4	21.4	23.8
Iron	20	24,800	2,000 or SB	22,700	20,700	21,600	31,000	19,400	21,100	19,200
Lead	0.6	12.5	SB	11.6	15.1	9.6	15.1	8.2	14.2	10.8
Magnesium	1,000	7,190	SB	6,390	6,220	5,860	7,600	5,990	5,810	5,270
Manganese	3	623	SB	579	537	557	1,250	543	566	522
Nickel	8	24.9	13 or SB	26.7	20.9	20.6	31	17.9	21.3	18.6
Potassium	1,000	1,394	SB	900	935	1,140	1,520	870	1,010	994
Silver	2	1.3	SB	1.7	0.52	1	1.4	0.58	0.41	0.72
Sodium	1,000	49.7	SB	50.2	48.7	51	70.8	51.1	45.6	46.4
Thallium	2	1.1	SB	0.13	0.15	0.18	0.14	0.13	0.13	0.14
Vanadium	10	14.5	150 or SB	10.4	11.9	12.8	19	10.2	11.9	11
Zinc	4	63.2	20 or SB	62	51.1	55.3	82.6	51.5	57.1	52.1

TABLE 6-14 (cont.)
SITE 2 SUBSURFACE SOIL SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION BKGRND. LIMITS	SITE 2 CONC.	NYSDC CONC.	MIW-02-17	MIW-02-31	MIW-03-22	MIW-03-32
VOCs (µg/kg)	10	NA	160	U	U	U	U
2-Butanone	10	NA	40	U	U	U	U
Benzene	10	NA	1,940	U	U	U	U
Carbon Disulfide	10	NA	1,190	U	U	U	U
Chlorobenzene	10	NA	160	U	U	U	U
Chloroform	10	NA	3,960	U	U	U	U
Ethylbenzene	10	NA	80	U	U	U	U
Methylene Chloride	10	NA	1,080	U	U	U	U
Toluene	10	NA	860	U	U	U	U
Total Xylenes	10	NA	270	U	U	U	U
SVOCs (µg/kg)	330	NA	270	280	380	360	360
2,4-Dichlorophenol	330	NA	26,170	3,800	39	360	360
2-Methylnaphthalene	330	NA	50,000	370	51	72	360
Bis(2-ethylhexyl)phthalate	330	NA	5,830	370	380	360	360
Di-n-butylphthalate	330	NA	50,000	370	380	360	360
Fluoranthene	330	NA	9,360	4,300	45	360	360
Naphthalene	330	NA	50,000	79	380	360	360
Phenanthrene	330	NA	50,000	370	380	360	360
Pyrene	330	NA	2,900	8,900	24	21	3.6
PEST/PCBs (µg/kg)	3.3	NA	2,100	110	0.32	R	3.6
4,4'-DDD	3.3	NA	1,750	9,400	40	J	3.6
4,4'-DDE	3.3	NA	540	16	1.9	J	3.6
4,4'-DDT	1.7	NA	540	63	1.9	U	1.8
alpha-Chlordane	1.7	NA	40	190	3.8	U	1.8
gamma-Chlordane	3.3	NA	40	190	3.8	U	3.6
Dieldrin	3.3	NA	40	190	3.8	U	3.6
INORGANICS (mg/kg)	40	11,900	SB	7,520	12,500	7,250	9,380
Aluminum	12	14.6	SB	4.7	9.7	4.5	5
Antimony	4	6.2	7.5 or SB	4	5.1	3.9	6.1
Arsenic	40	53.8	300 or SB	17.2	82.9	24.7	40.9
Barium	1	0.96	0.16 or SB	0.24	0.5	0.55	0.61
Beryllium	1,000	23,400	SB	23,400	24,300	21,500	29,900
Calcium	2	17.5	10 or SB	11.6	20.7	10.4	12.2
Chromium	10	11.8	30 or SB	7.5	11.9	7.3	8.6
Cobalt	5	28	25 or SB	18.2	28.4	16.9	18.5
Copper	20	24,800	2,000 or SB	16,600	25,900	16,400	18,600
Iron	0.6	12.5	SB	7.7	17.6	10.1	9.8
Lead	1,000	7,190	SB	5,810	6,930	4,270	5,460
Magnesium	3	623	SB	466	667	377	498
Manganese	8	24.9	13 or SB	15.8	23.9	15.7	17.2
Nickel	1,000	1,394	SB	622	1,210	J	1,020
Potassium	2	1.3	SB	0.42	0.87	U	0.42
Silver	1,000	49.7	SB	40.6	49.8	14.5	30.4
Sodium	2	1.1	SB	0.24	0.25	U	0.26
Thallium	10	14.5	150 or SB	8	13.7	9	11.5
Vanadium	4	63.2	20 or SB	40.6	79.2	J	46.9
Zinc	4	63.2	20 or SB	40.6	79.2	J	46.9

NOTES:
1) Detection Limit
2) Contract Required Quantitation Limits for Inorganics
3) Contract Required Quantitation Limits for Inorganics
4) Indicates concentration that exceeds either site-specific background concentration or NYSDC Clean-Up Goal

DATA QUALITIES:
J - Estimated Value
R - Rejected Value

NYSDC - New York State Department of Environmental Conservation
PEST/PCBs - Pesticides/Polychlorinated Biphenyls
SVOCs - Semi-Volatile Organic Compounds
VOCs - Volatile Organic Compounds
µg/kg - micrograms per kilogram

Last Revision Date: 10/2/96

C:\ACDWGS\ANG\STEWART\RI\SECTF_LR.DWG

F (west)

ELEVATION (FEET ABOVE MEAN SEA LEVEL)

435
430
425
420
415
410
405
400
395

SB-04

SB-06

VOCs (µg/kg)	ND
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	6.1J
4,4'-DDE	5.1
4,4'-DDT	15
Dieldrin	9.1J
INORGANICS (mg/kg)	
Manganese	664

VOCs (µg/kg)	
Total Xylenes	2
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	ND
INORGANICS (mg/kg)	ND

Former Location of Site 2
Pesticide Pit Burial Area

VOCs (µg/kg)	
Benzene	2
Carbon Disulfide	3J
Toluene	1J
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	ND
INORGANICS (mg/kg)	
Manganese	642

VOCs (µg/kg)	
Chloroform	2
Methylene Chloride	1
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	9.9J
4,4'-DDE	0.64J
4,4'-DDT	19
INORGANICS (mg/kg)	
Aluminum	15,600
Chromium	27.5
Copper	30.8
Iron	31,000
Lead	13.5J
Magnesium	7,600
Manganese	1,250
Potassium	1,520
Silver	1.4
Zinc	82.5J

STEWART AIR NATION

LABORATORY ANALYT

SUBSURFACE SOIL CONTAMINANT DIST

NEWBURGH, NEW

SB-06

MW-

Location of Site 2
Side Pit Burial Area

VOCs (µg/kg)	
Toluene	3
Total Xylenes	3
SVOCs (µg/kg)	
Di-n-butylphthalate	37
PEST./PCBs (µg/kg)	
4,4'-DDD	0.41J
4,4'-DDE	0.15J
INORGANICS (mg/kg)	
Chromium	15.7
Manganese	37.0

Weathered Till

Lodgement Till

VOCs (µg/kg)	
Ethylbenzene	17
SVOCs (µg/kg)	
2-Methylnaphthalene	2,300
Naphthalene	1,500
PEST./PCBs (µg/kg)	
4,4'-DDD	890J
4,4'-DDE	43J
4,4'-DDT	4,500
alpha-Chlordane	4.4J
INORGANICS (mg/kg)	
	ND

VOCs (µg/kg)	
Chloroform	2
Methylene Chloride	1
SVOCs (µg/kg)	
ND	
PEST./PCBs (µg/kg)	
4,4'-DDD	9.9J
4,4'-DDE	0.64J
4,4'-DDT	19
INORGANICS (mg/kg)	
Aluminum	15,600
Chromium	27.5
Copper	38.8
Iron	35,000
Lead	13.5
Magnesium	7,600
Manganese	3,250
Potassium	1,320
Silver	1.4
Zinc	82.6

VOCs (µg/kg)	
Benzene	1
Carbon Disulfide	1
Toluene	1
SVOCs (µg/kg)	
ND	
PEST./PCBs (µg/kg)	
ND	
INORGANICS (mg/kg)	
Calcium	23,800
Sodium	30.4

Weathered
Fractured
Bedrock

STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS

SUBSURFACE SOIL CONTAMINANT DISTRIBUTION CROSS SECTION F - F'

NEWBURGH, NEW YORK

(2)

F' (east)

MW-03

Edge of Site 1
Former Base Landfill

Weathered Till




odgement Till

VOCs ($\mu\text{g/kg}$)	ND
SVOCs ($\mu\text{g/kg}$)	
Bis(2-ethylhexyl)phthalate	72
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	21J
4,4'-DDT	59J
INORGANICS (mg/kg)	ND

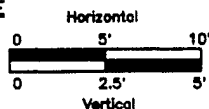
VOCs ($\mu\text{g/kg}$)	
Benzene	1
Carbon Disulfide	1
Toluene	1
SVOCs ($\mu\text{g/kg}$)	ND
PEST./PCBs ($\mu\text{g/kg}$)	ND
INORGANICS (mg/kg)	
Calcium	23,900
Sodium	50.4

Weathered
Fractured
Bedrock

LEGEND

- SB Soil Boring Locations
- MW
-  Sample Location
- ND Not Detected for Organics
- ND Not Detected above Site-Specific Background or NYSDEC Clean-up Concentrations for Inorganics
- mg/kg milligrams per kilogram
- $\mu\text{g/kg}$ micrograms per kilogram
-  Concentration Exceeds NYSDEC Clean-up Concentrations
-  Weathered fractured bedrock

SCALE



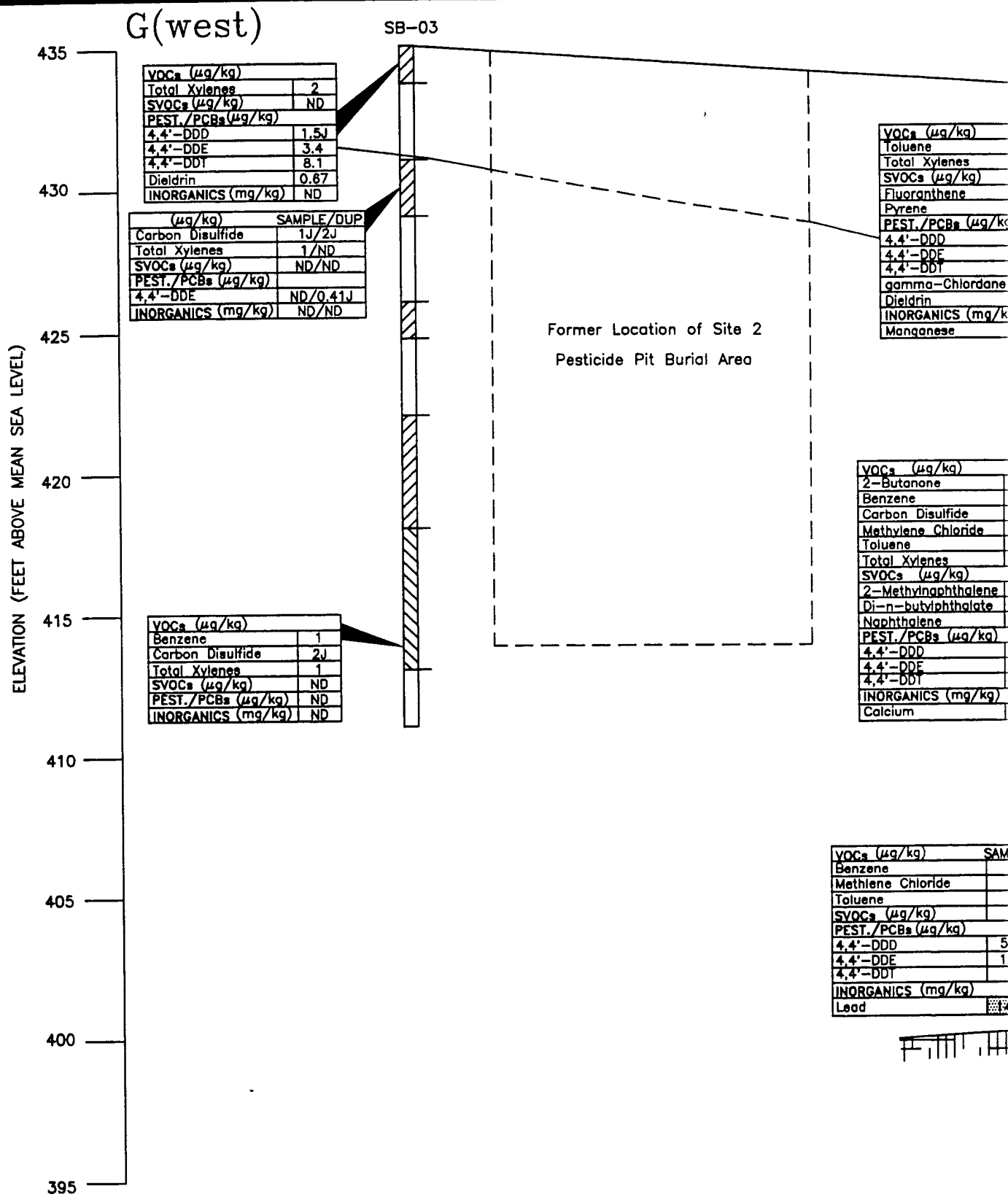
**ANEPTEK
CORPORATION**
Analytic, Environmental
and Process Technologies

SECTION F - F'

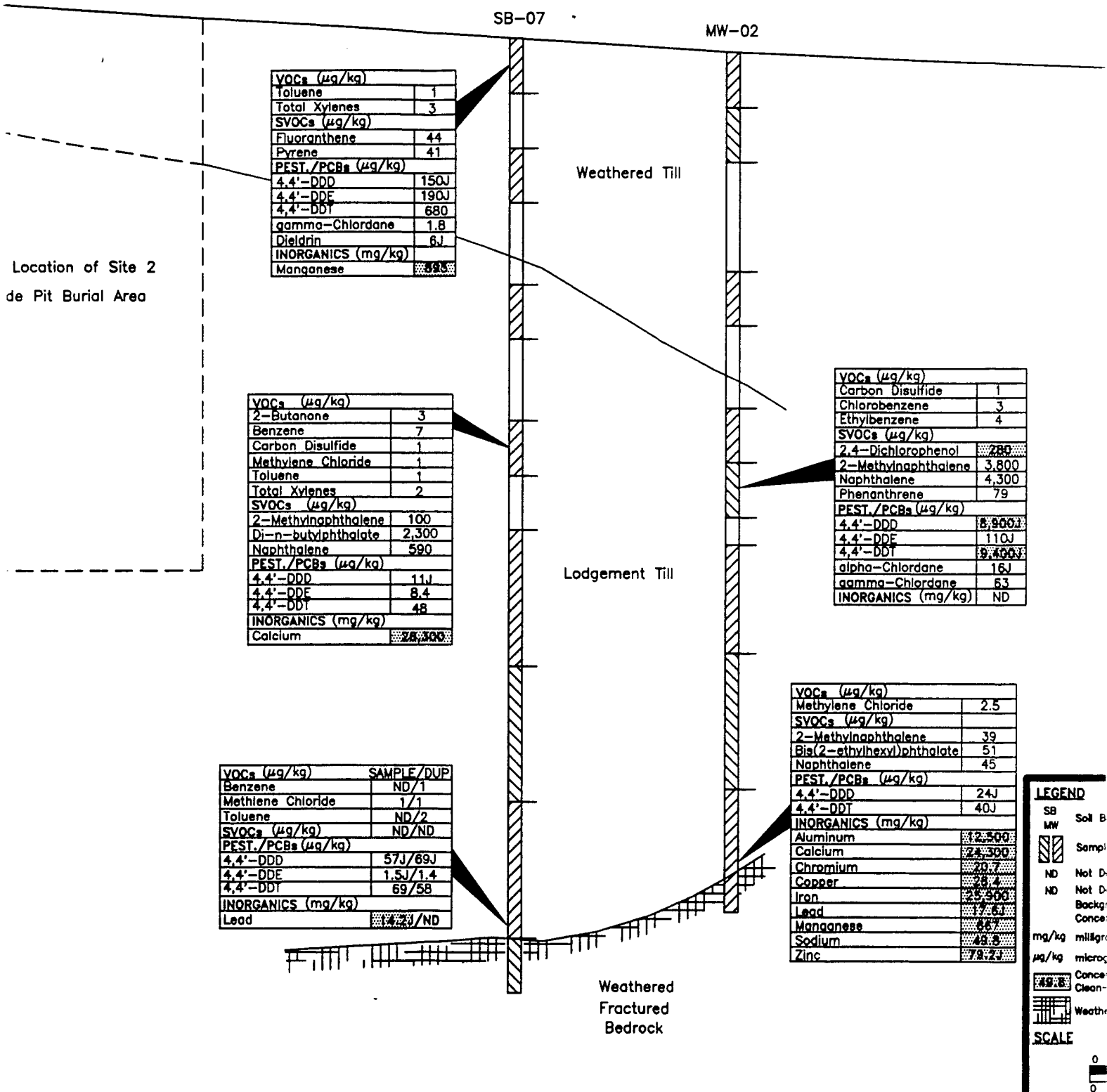
FIGURE: 6-19

Last Revision Date: 3/18/97

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STEWART AIR NATION
LABORATORY ANALYTIC
SUBSURFACE SOIL CONTAMINANT DISTR
NEWBURGH, NEW



LEGEND

SB Soil B

MW Sample

ND Not D

ND Not D

ND Backgr

Conce

mg/kg milligr

µg/kg microg

Conce

Clean

Weather

SCALE

0

0

G'(east)

MW-02

Edge of Fill
Site 1 Former
Base Landfill

red Till

ent Till

athered
ctured
d rock

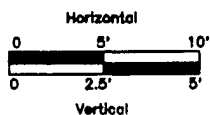
VOCs (µg/kg)	
Carbon Disulfide	1
Chlorobenzene	3
Ethylbenzene	4
SVOCs (µg/kg)	
2,4-Dichlorophenol	280
2-Methylnaphthalene	3,800
Naphthalene	4,300
Phenanthrene	79
PEST./PCBs (µg/kg)	
4,4'-DDD	8,900
4,4'-DDE	110
4,4'-DDT	9,400
alpha-Chlordane	16
gamma-Chlordane	63
INORGANICS (mg/kg)	
	ND

VOCs (µg/kg)	
Methylene Chloride	2.5
SVOCs (µg/kg)	
2-Methylnaphthalene	39
Bis(2-ethylhexyl)phthalate	51
Naphthalene	45
PEST./PCBs (µg/kg)	
4,4'-DDD	24
4,4'-DDT	40
INORGANICS (mg/kg)	
Aluminum	12,500
Calcium	24,300
Chromium	20.7
Copper	25.4
Iron	25,500
Lead	19.8
Manganese	6.7
Sodium	48.5
Zinc	72.2

LEGEND

- SB Soil Boring Locations
MW Sample Location
ND Not Detected for Organics
ND Not Detected above Site-Specific Background or NYSDEC Clean-up Concentrations for Inorganics
mg/kg milligrams per kilogram
µg/kg micrograms per kilogram
Concentration Exceeds NYSDEC Clean-up Concentrations
Weathered fractured bedrock

SCALE



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ION G - G'

FIGURE: 6-20

Last Revision Date: 3/18/97

C:\ACDWGS\ANG\STEWART\RI\SECTH_LR.DWG

ELEVATION (FEET ABOVE MEAN SEA LEVEL)

435
430
425
420
415
410
405
400
395

H (west)

SB-02

SB-07

VOCs (µg/kg)	
Total Xylenes	1
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	2J
4,4'-DDE	18
INORGANICS (mg/kg)	ND

VOCs (µg/kg)	
Carbon Disulfide	2J
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	1.1J
4,4'-DDE	2.3J
4,4'-DDT	3.6J
Dieldrin	0.2
INORGANICS (mg/kg)	ND

VOCs (µg/kg)	
Carbon Disulfide	2J
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	1.2J
4,4'-DDE	2.3
4,4'-DDT	3.6
INORGANICS (mg/kg)	ND

Weathered Till

Lodgement Till

VOCs (µg/kg)	
Toluene	
Total Xylenes	
SVOCs (µg/kg)	
Fluoranthene	
Pyrene	
PEST./PCBs (µg/kg)	
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
gamma-Chlordane	
Dieldrin	
INORGANICS (mg/kg)	
Manganese	

FORMER LC PESTICIDE

VOCs (µg/kg)	
2-Butanol	
Benzene	
Carbon Disulfide	
Methylene Chloride	
Toluene	
Total Xylenes	
SVOCs (µg/kg)	
2-Methyl-2-butanol	
Di-n-butylphthalate	
PEST./PCBs (µg/kg)	
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
INORGANICS (mg/kg)	
Calcium	

VOCs (µg/kg)	
Carbon Disulfide	
Methylene Chloride	
Toluene	
SVOCs (µg/kg)	
PEST./PCBs (µg/kg)	
4,4'-DDD	
4,4'-DDE	
4,4'-DDT	
INORGANICS (mg/kg)	
Lead	

STEWART AIR NATIONAL AIRFIELD

LABORATORY ANALYSIS
PROJECTED SUBSURFACE SOIL CONTAMINATION

NEWBURGH, NY

①

SB-07

SB-06

SB-05

Weathered Till

Lodgement Till

VOCs (µg/kg)	
Toluene	1
Total Xylenes	3
SVOCs (µg/kg)	
Fluoranthene	44
Pyrene	41
PEST./PCBs (µg/kg)	
4,4'-DDD	150J
4,4'-DDE	190J
4,4'-DDT	680
gamma-Chlordane	1.8
Dieldrin	6J
INORGANICS (mg/kg)	
Manganese	825

FORMER LOCATION OF SITE 2
PESTICIDE PIT BURIAL AREA

VOCs (µg/kg)	
2-Butanone	3
Benzene	7
Carbon Disulfide	1
Methylene Chloride	1
Toluene	1
Total Xylenes	2
SVOCs (µg/kg)	
2-Methylnaphthalene	100
Di-n-butylphthalate	2,300
Naphthalene	590
PEST./PCBs (µg/kg)	
4,4'-DDD	11J
4,4'-DDE	8.4
4,4'-DDT	48
INORGANICS (mg/kg)	
Calcium	28,300

VOCs (µg/kg)		SAMPLE/DUP.	
Carbon Disulfide		ND/1	
Methylene Chloride		1/1	
Toluene		ND/2	
SVOCs (µg/kg)		ND/ND	
PEST./PCBs (µg/kg)			
4,4'-DDD		57J/69J	
4,4'-DDE		1.5J/1.4	
4,4'-DDT		69/58	
INORGANICS (mg/kg)			
Lead		ND	

VOCs (µg/kg)	
Toluene	3
Total Xylenes	3
SVOCs (µg/kg)	
Di-n-butylphthalate	37
PEST./PCBs (µg/kg)	
4,4'-DDD	0.41J
4,4'-DDE	0.15J
INORGANICS (mg/kg)	
Chromium	18.7
Manganese	1,070

VOCs (µg/kg)	
Ethylbenzene	17
SVOCs (µg/kg)	
2-Methylnaphthalene	2,300
Naphthalene	1,500
PEST./PCBs (µg/kg)	
4,4'-DDD	890J
4,4'-DDE	43J
4,4'-DDT	4,300
alpha-Chlordane	4.4J
INORGANICS (mg/kg)	
	ND

VOCs (µg/kg)	
Chloroform	2
Methylene Chloride	1
SVOCs (µg/kg)	
	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	9.9J
4,4'-DDE	0.64J
4,4'-DDT	19
INORGANICS (mg/kg)	
Aluminum	13,600
Chromium	27.5
Copper	35.5
Iron	31,000
Lead	13.5J
Magnesium	7,600
Manganese	1,250
Potassium	1,520
Sodium	1.4
Zinc	82.6J

STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS

ED SUBSURFACE SOIL CONTAMINANT DISTRIBUTION CROSS SECTION H - H'

NEWBURGH, NEW YORK

2

SB-06

SB-05

H (east)

VOCs ($\mu\text{g/kg}$)	
Toluene	3
Total Xylenes	3
SVOCs ($\mu\text{g/kg}$)	
Di-n-butylphthalate	37
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	0.41J
4,4'-DDE	0.15J
INORGANICS (mg/kg)	
Chromium	18.7
Manganese	1,070

VOCs ($\mu\text{g/kg}$)	
Methylene Chloride	1
SVOCs ($\mu\text{g/kg}$)	
ND	ND
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	0.75
4,4'-DDE	1.5
Dieldrin	0.32
INORGANICS (mg/kg)	
Manganese	652




VOCs ($\mu\text{g/kg}$)	
Methylene Chloride	2
SVOCs ($\mu\text{g/kg}$)	
ND	ND
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	44
4,4'-DDE	3.5J
4,4'-DDT	18
Dieldrin	11
INORGANICS (mg/kg)	
Lead	11.6J
Nickel	28.7
Silver	1.7

VOCs ($\mu\text{g/kg}$)	
Methylene Chloride	2
SVOCs ($\mu\text{g/kg}$)	
ND	ND
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	19
4,4'-DDE	35J
4,4'-DDT	49
Dieldrin	7J
INORGANICS (mg/kg)	
Lead	13.1J

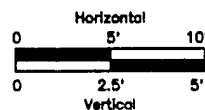
VOCs ($\mu\text{g/kg}$)	
Ethylbenzene	17
SVOCs ($\mu\text{g/kg}$)	
2-Methylnaphthalene	2,300
Naphthalene	1,500
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	890J
4,4'-DDE	4.3J
4,4'-DDT	4,300
alpha-Chlordane	4.4J
INORGANICS (mg/kg)	
ND	ND

VOCs ($\mu\text{g/kg}$)	
Chloroform	2
Methylene Chloride	1
SVOCs ($\mu\text{g/kg}$)	
ND	ND
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	9.9J
4,4'-DDE	0.64J
4,4'-DDT	19
INORGANICS (mg/kg)	
Aluminum	15,600
Chromium	27.5
Copper	35.8
Iron	31,000
Lead	13.1J
Magnesium	7,800
Manganese	1,250
Potassium	1,520
Sodium	1.2
Zinc	82.6J

LEGEND

- SB Soil Boring Locations
 Sample Location
 ND Not Detected for Organics
 ND Not Detected above Site-Specific Background or NYSDEC Clean-up Concentrations for Inorganics
 mg/kg milligrams per kilogram
 $\mu\text{g/kg}$ micrograms per kilogram
 Concentration Exceeds NYSDEC Clean-up Concentrations
 Weathered Fractured Bedrock

SCALE



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BASE

TS

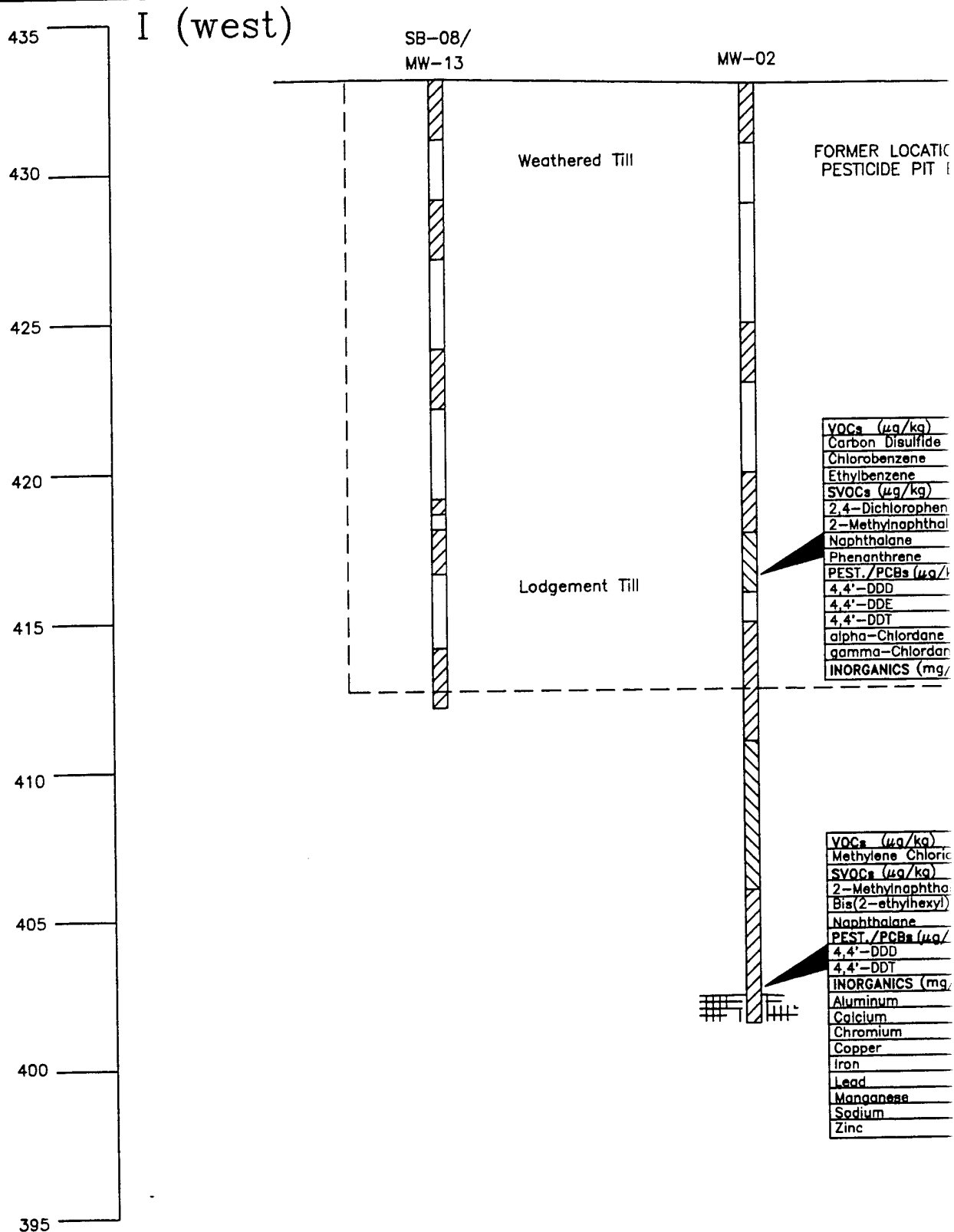
N CROSS SECTION H - H'

FIGURE: 6-21

Last Revision Date: 3/19/97

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ELEVATION (FEET ABOVE MEAN SEA LEVEL)



STEWART AIR NATION

LABORATORY ANALYSIS
PROJECTED SUBSURFACE SOIL CONTAMINATION

NEWBURGH, NEW YORK

I' (east)

MW-02

MW-03

Weathered Till

FORMER LOCATION OF SITE 2
PESTICIDE PIT BURIAL AREA

odgement Till

VOCs (µg/kg)	
Carbon Disulfide	1
Chlorobenzene	3
Ethylbenzene	4
SVOCs (µg/kg)	
2,4-Dichlorophenol	280
2-Methylnaphthalene	3,800
Naphthalene	4,300
Phenanthrene	79
PEST./PCBs (µg/kg)	
4,4'-DDD	8,900J
4,4'-DDE	110J
4,4'-DDT	8,400J
alpha-Chlordane	16J
gamma-Chlordane	63
INORGANICS (mg/kg)	ND

VOCs (µg/kg)	ND
SVOCs (µg/kg)	
Bis(2-ethylhexyl)phthalate	72
PEST./PCBs (µg/kg)	
4,4'-DDD	21J
4,4'-DDT	59J
INORGANICS (mg/kg)	ND

VOCs (µg/kg)	
Methylene Chloride	2.5
SVOCs (µg/kg)	
2-Methylnaphthalene	39
Bis(2-ethylhexyl)phthalate	51
Naphthalene	45
PEST./PCBs (µg/kg)	
4,4'-DDD	24J
4,4'-DDT	40J
INORGANICS (mg/kg)	
Aluminum	12,500
Calcium	24,300
Chromium	20.7
Copper	28.4
Iron	25,800
Lead	17.8J
Manganese	68.7
Sodium	49.8
Zinc	79.2J

VOCs (µg/kg)	
Benzene	1
Carbon Disulfide	1
Toluene	1
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
INORGANICS (mg/kg)	ND
Calcium	28,900
Sodium	30.4

STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS

TED SUBSURFACE SOIL CONTAMINANT DISTRIBUTION CROSS SECTION I - I'

NEWBURGH, NEW YORK

(2)




I' (east)

MW-03

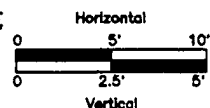
VOCs ($\mu\text{g/kg}$)	ND
SVOCs ($\mu\text{g/kg}$)	
Bis(2-ethylhexyl)phthalate	72
PEST./PCBs ($\mu\text{g/kg}$)	
4,4'-DDD	21J
4,4'-DDT	59J
INORGANICS (mg/kg)	ND

VOCs ($\mu\text{g/kg}$)	
Benzene	1
Carbon Disulfide	1
Toluene	1
SVOCs ($\mu\text{g/kg}$)	ND
PEST./PCBs ($\mu\text{g/kg}$)	ND
INORGANICS (mg/kg)	
Calcium	28,900
Sodium	30.4

LEGEND

- SB Soil Boring Locations
- MW
-  Sample Location
- ND Not Detected for Organics
- ND Not Detected above Site-Specific Background or NYSDEC Clean-up Concentrations for Inorganics
- mg/kg milligrams per kilogram
- $\mu\text{g/kg}$ micrograms per kilogram
-  Concentration Exceeds NYSDEC Clean-up Concentrations
-  Weathered Fractured Bedrock

SCALE

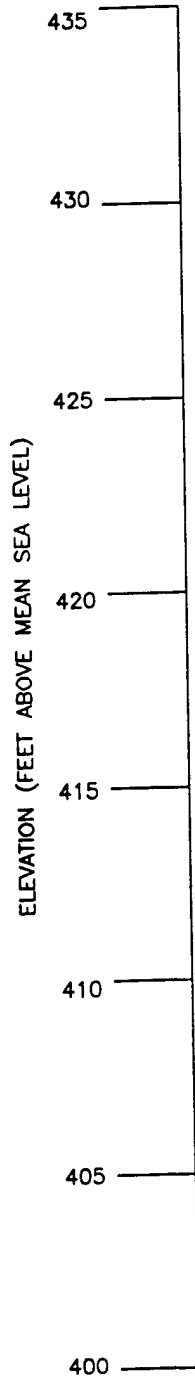


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FIGURE: 6-22

J (west)

SB-04



VOCs (µg/kg)	ND
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	
4,4'-DDD	6.1J
4,4'-DDE	5.1
4,4'-DDT	15.0
Dieldrin	9.1
INORGANICS (mg/kg)	
Manganese	86.4

VOCs (µg/kg)	
Total Xylenes	2
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	ND
INORGANICS (mg/kg)	
Calcium	35,000

FORMER LOCATION OF SITE 2
PESTICIDE PIT BURIAL AREA

VOCs (µg/kg)	
Benzene	2
Carbon Disulfide	3J
Toluene	1J
SVOCs (µg/kg)	ND
PEST./PCBs (µg/kg)	ND
INORGANICS (mg/kg)	ND

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STEWART AIR NATIONAL

LABORATORY ANALYTIC

SUBSURFACE SOIL CONTAMINANT DISTRI

NEWBURGH, NEW YC

J'

SB

SB-07

ND
ND
6.1J
5.1
15.0
9.1
864
2
ND
ND
35,000

RMER LOCATION OF SITE 2
ESTICIDE PIT BURIAL AREA

2
3J
1J
ND
ND
ND

VOCs (μg/kg)	
Toluene	1
Total Xylenes	3
SVOCs (μg/kg)	
Fluoranthene	44
Pyrene	14
PEST./PCBs (μg/kg)	
4,4'-DDD	150J
4,4'-DDE	190J
4,4'-DDT	680
Gamma-Chlordane	1.8
Dieldrin	6J
INORGANICS (mg/kg)	
Manganese	885

VOCs (μg/kg)	
2-Butanone	3
Benzene	7
Carbon Disulfide	1
Methylene Chloride	1
Toluene	1
Total Xylenes	2
SVOCs (μg/kg)	
2-Methylnaphthalene	100
Di-n-Butylphthalate	2300
Naphthalene	590
PEST./PCBs (μg/kg)	
4,4'-DDD	11J
4,4'-DDE	8.4
4,4'-DDT	48
INORGANICS (mg/kg)	
Calcium	28,300

LEGEND

SB	Sc
MW	Sc
ND	Nc
ND	Nc
ND	Bc
ND	Cc
mg/kg	m
μg/kg	m
49.8	Cc
49.8	Cc

SCALE

STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS

SURFACE SOIL CONTAMINANT DISTRIBUTION CROSS SECTION J - J'

NEWBURGH, NEW YORK

FIG

②

6-51

J' (east)



SB-07

SB-08/MW-13

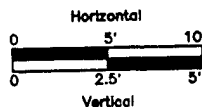
VOCs (μg/kg)	
Toluene	1
Total Xylenes	3
SVOCs (μg/kg)	
Fluoranthene	44
Pyrene	14
PEST./PCBs (μg/kg)	
4,4'-DDD	150J
4,4'-DDE	190J
4,4'-DDT	680
Gamma-Chlordane	1.8
Dieldrin	6J
INORGANICS (mg/kg)	
Manganese	885

VOCs (μg/kg)	
2-Butanone	3
Benzene	7
Carbon Disulfide	1
Methylene Chloride	1
Toluene	1
Total Xylenes	2
SVOCs (μg/kg)	
2-Methylnaphthalene	100
Di-n-Butylphthalate	2300
Naphthalene	590
PEST./PCBs (μg/kg)	
4,4'-DDD	11J
4,4'-DDE	8.4
4,4'-DDT	48
INORGANICS (mg/kg)	
Calcium	28,300

LEGEND

- SB Soil Boring Locations
 MW
 Sample Location
 ND Not Detected for Organics
 ND Not Detected above Site-Specific Background or NYSDEC Clean-up Concentrations for Inorganics
 mg/kg milligrams per kilogram
 μg/kg micrograms per kilogram
 Concentration Exceeds NYSDEC Clean-up Concentrations

SCALE



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ASE

SS SECTION J - J'

FIGURE: 6-23

µg/kg, respectively. With the exception of dieldrin, sample MW-02-17 contained the highest concentrations of pesticides detected in all soil samples.

TCL VOCs and SVOCs: In general, low levels of organic and inorganic compounds were detected in soil samples. The majority of VOC and SVOC compounds detected were fuel-related compounds, detected at concentrations below their respective clean-up goals. Fuel-related compounds detected at these concentrations would be expected to be ubiquitous in an industrialized area such as the Stewart International Airport. Bis(2-ethylhexyl)phthalate (BEHP) and di-n-butylphthalate were detected at low levels in isolated sample locations. Both of these compounds are common laboratory contaminants and were not detected above their respective NYSDEC Cleanup Goals.

TAL Metals: Several inorganic analytes were detected at concentrations above their respective site-specific background and NYSDEC Cleanup Goals. Table 6-14 shows that the majority of the detected inorganic analytes only slightly exceed either their background concentrations or respective NYSDEC Cleanup Goals. Samples SB-06-34.5 and MW-02-31 contained the highest concentrations of inorganic analytes, with respect to the number of analytes detected above acceptable levels as well as the concentrations detected. Both of these samples were collected from the overburden/weathered fractured shale interface, east of the pit.

6.3.3 Sediment

A total of 7 sediment samples, including background locations, were submitted for off-site laboratory analysis. Table 6-15 presents a summary of the analytical results for all sediment samples. Figure 6-24 summarizes the distribution of sediment sample detected contaminants.

TCL Pesticides/PCBs: Low concentrations of the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT and dieldrin were detected in every sediment sample collected. As noted in Section 6.2.3, these compounds are probably ubiquitous to surficial soils at the Base. Pesticides detected in sediments at concentrations exceeding NYSDEC Cleanup Goals were 4,4'-DDT in sample SS-06 (16 µg/kg), and 4,4'-DDE (18 µg/kg), 4,4'-DDT (36 µg/kg), and dieldrin (86 µg/kg) in sample SS-04.

TCL VOCs and SVOCs: All detections of VOCs and SVOCs in sediment samples were below their respective NYSDEC Cleanup Goals. Total xylenes, with a maximum detection of 5 µg/kg, was the only VOC detected in any of the sediment samples collected. Di-n-butylphthalate, a common laboratory contaminant, was detected in 3 out of the 7 samples collected, including the background sample SS-01. The remainder of the SVOCs detected in sediment samples consisted of fuel-related polycyclic aromatic hydrocarbons (PAHs). Sample SS-04 contained a significantly greater number of SVOCs than all of the other sediment samples collected. As stated in Section 5.4.2, the location from which SS-04 was collected receives stormwater runoff from the vicinity of Site 2 as well as other areas of the Base. Surface runoff originating from the paved lot adjacent to the Auto Maintenance facility flows over the location from which SS-04 was collected.

TABLE 6-15
SITE 2 SEDIMENT SAMPLE ANALYSIS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	SITE 2 BKGRND. CONC.	NYSDEC CLEANUP CONC. ¹	SAMPLE NUMBER					
				SS-02	SS-04	SS-05	SS-15	SS-06	SS-07
VOCs (µg/kg)	10	NA	860	11	12	3	2	2	5
Total Xylenes									
SVOCs (µg/kg)	330	NA	224 or MDL	360	170	400	410	390	380
Benzo(a)anthracene	330	NA	609 or MDL	360	220	400	410	390	380
Benzo(a)pyrene	330	NA	790	360	310	400	410	390	380
Benzo(b)fluoranthene	330	NA	790	360	160	400	410	390	380
Benzo(k)fluoranthene	330	NA	50000	360	210	400	410	390	380
Benzo(g,h,i)perylene	330	NA	50000	360	92	400	410	390	380
Carbazole	330	NA	290	360	260	400	410	390	380
Chrysene	330	NA	140 or MDL	360	56	400	410	390	380
Dibenzo(a,h)anthracene	330	NA	5,830	360	400	400	410	390	380
Di-n-butylphthalate	330	NA	2300	360	180	400	410	390	380
Iodeno(1,2,3-cd)pyrene	330	NA	50,000	360	480	400	410	390	380
Fluoranthene	330	NA	50,000	360	210	400	410	390	380
Phenanthrene	330	NA	50,000	360	370	400	410	390	380
Pyrene	330	NA	50,000	360	370	400	410	390	380
PEST/PCBs (µg/kg)	3.3	NA	2,900	6.1	6.2	4	4.1	4.4	3.8
4,4'-DDD	3.3	NA	2,100	2.6	18	2.1	1.9	9.4	4.4
4,4'-DDE	3.3	NA	1,750	2.1	36	0.59	0.29	16	1.4
4,4'-DDT	3.3	NA	40	2.5	86	5.6	4.3	5.7	1.3
Dieldrin	3.3	NA							
INORGANICS (mg/kg)	40	12,500	SB	10,000	11,200	11,900	13,400	10,300	14,100
Aluminum	2	4.4	7.5 or SB	4.2	2.8	4.7	4	5.2	2.6
Arsenic	40	45.1	300 or SB	33.6	50.6	59.4	60	44.5	70.3
Barium	1	0.84	0.16 or SB	0.67	0.46	0.74	1.1	0.39	0.63
Beryllium	2	15.6	10 or SB	14	12.8	14.4	17.2	13.5	13.3
Chromium	10	10.6	30 or SB	9.7	8.5	10.3	12.2	10	7.6
Cobalt	5	24.2	25 or SB	19.9	15.5	24.3	27.7	22	14.1
Copper	20	23,400	2,000 or SB	22,200	19,500	23,600	26,600	21,500	19,600
Lead	0.6	14.6	SB	17.6	21.5	16.9	13.9	17.7	15.7
Magnesium	1,000	5,030	SB	6,970	3,570	4,650	5,190	4,390	3,570
Manganese	3	672	SB	566	724	1,240	1,170	647	753
Mercury	0.1	ND	0.10	0.04	0.05	0.04	0.04	0.04	0.04
Nickel	8	28.6	13 or SB	21.5	17.1	21.1	26.3	22.4	17.4
Potassium	1,000	636	SB	632	624	609	1,020	950	654
Silver	2	0.5	SB	0.82	0.67	0.9	0.93	0.46	0.51
Thallium	2	0.13	SB	0.13	0.14	0.17	0.15	0.14	0.6
Vanadium	10	17.5	150 or SB	13.5	17.6	16	17.7	14.3	17.2
Zinc	4	61.4	20 or SB	64.3	60.7	95.5	76.9	61.7	57.7

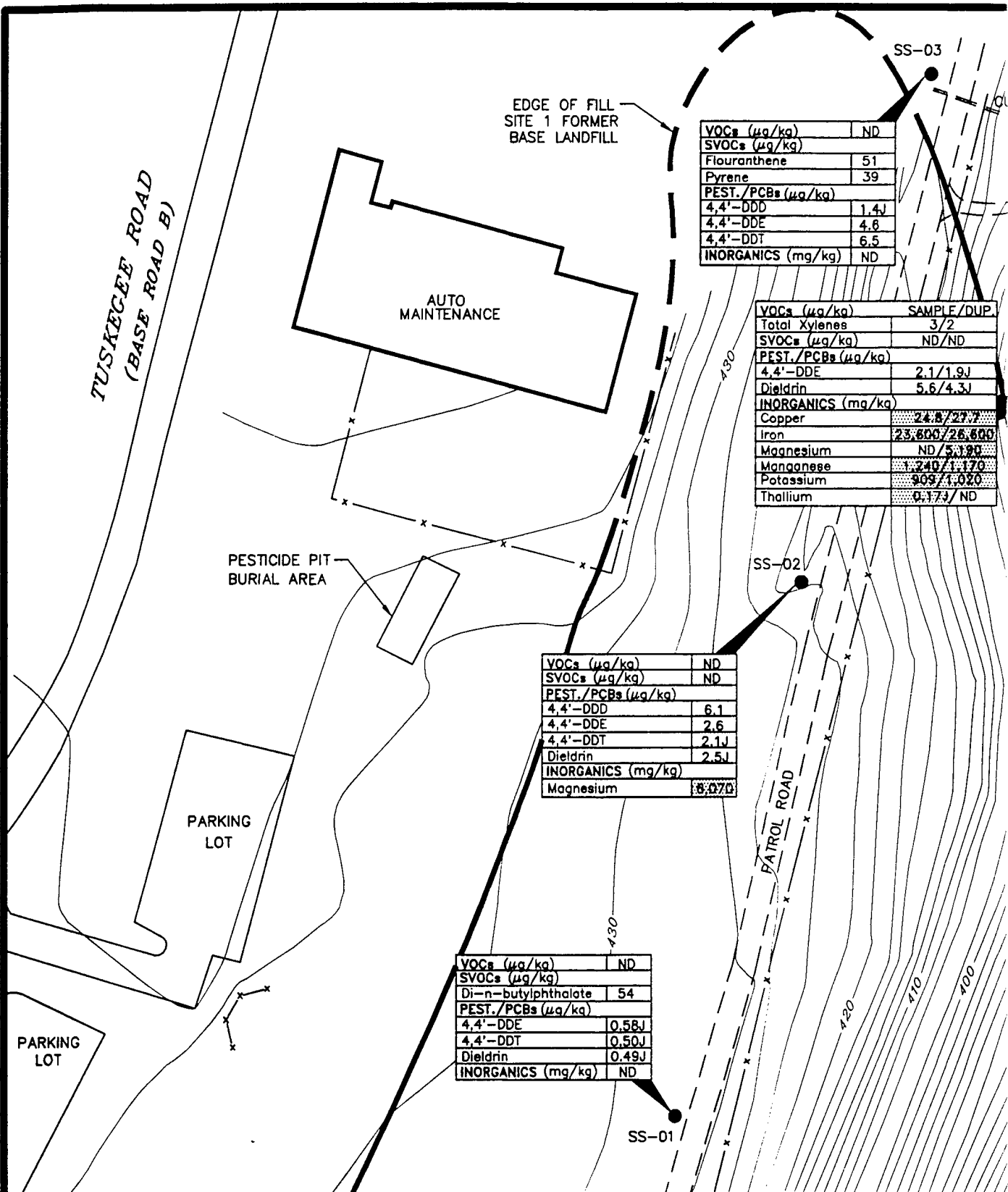
ABBREVIATIONS
4,4'-DDD - Dichlorodiphenylchloroethane
4,4'-DDE - Dichlorodiphenylchloroethane
4,4'-DDT - Dichlorodiphenylchloroethane
mg/kg - milligrams per kilogram
ND - Not Detected
NYSDEC - New York State Department of Environmental Conservation
PEST/PCBs - Pesticides/Polychlorinated Biphenyls
SVOCs - Semi-Volatile Organic Compounds
VOCs - Volatile Organic Compounds
µg/kg - micrograms per kilogram

DATA QUALIFIERS
J - Estimated Value
R - Rejected Value
U - Below Detection Limit

NOTES
1) Detection Limits
- Contract Required Detection Limits for Organics
- Contract Required Quantitation Limits for Inorganics
2) NYSDEC TAGM HWR-94-4046, January 24, 1994
- Indicates concentration that exceeds either State or Federal regulatory limits.

Last Revision Date: 9/19/96

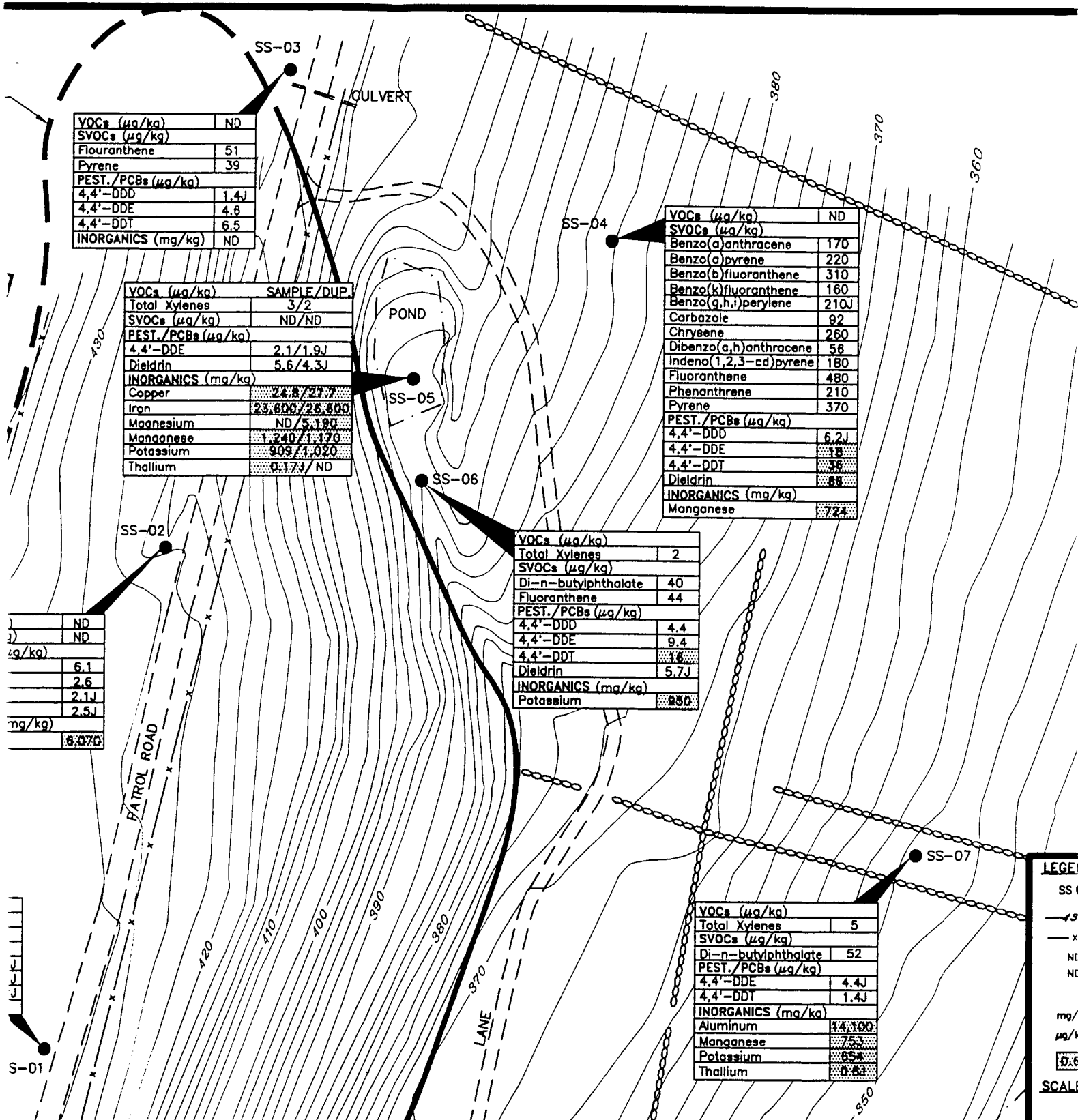
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STEWART AIR NATION

LABORATORY ANALYT
SEDIMENT SAMPLE

NEWBURGH, NE

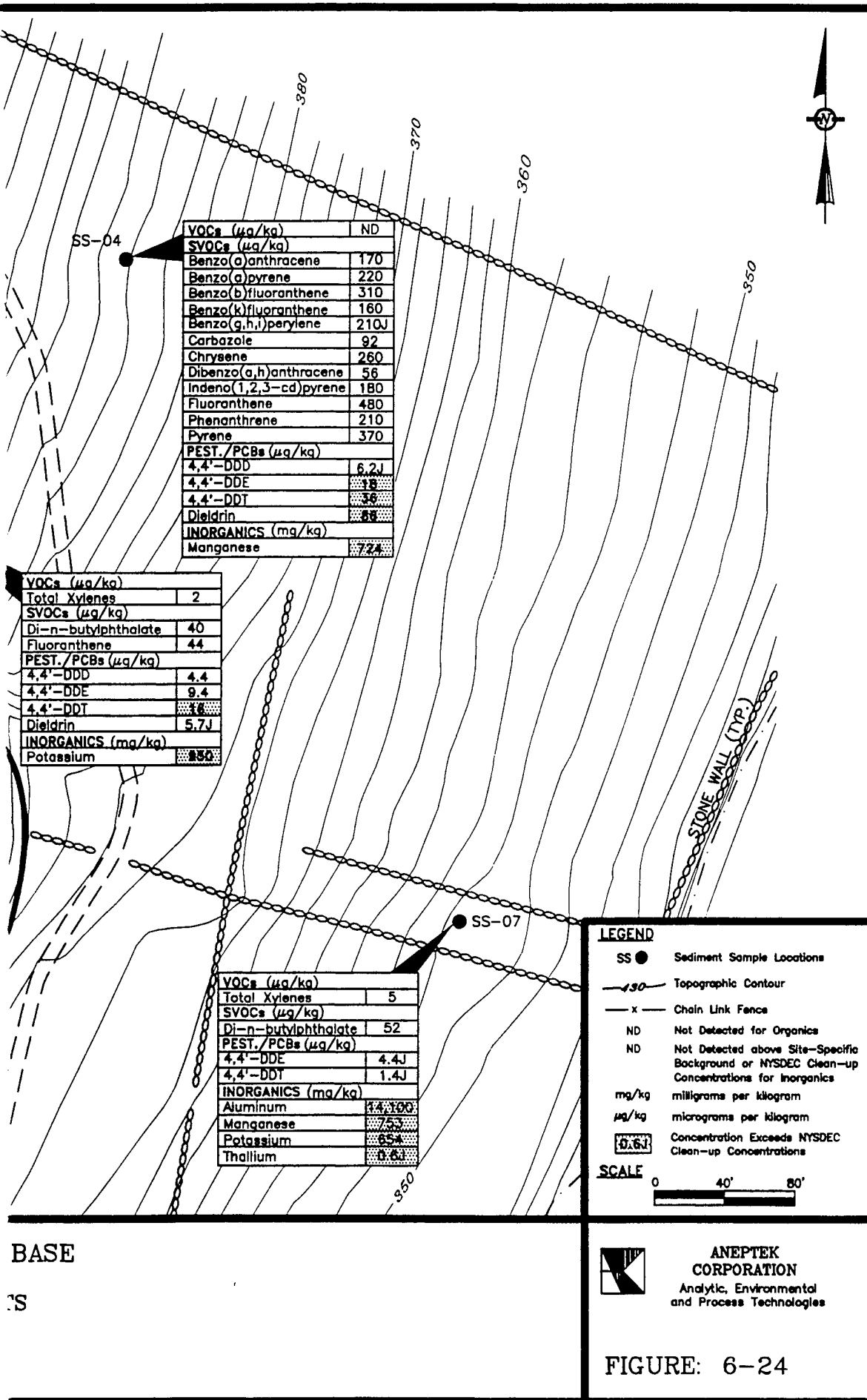


STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS
SEDIMENT SAMPLE LOCATIONS

NEWBURGH, NEW YORK

FIG



TAL Metals: Inorganic analytes detected at concentrations greater than NYSDEC Cleanup Goals in sediment samples include aluminum, copper, iron, magnesium, manganese, potassium, and thallium. Sample SS-05, collected from the ponded area, was found to contain the highest concentrations of inorganic analytes.

6.3.4 Groundwater

Groundwater samples at Site 2 were collected during two sample collection rounds; the first in November 1995 followed by a second round in March 1996. During each round, eight groundwater samples were submitted for off-site laboratory analysis. Tables 6-16 and 6-17 present summaries of the analytical results for all groundwater samples collected and analyzed in November 1995 and March 1996, respectively. Figures 6-25 and 6-26 present summaries of the distribution of contaminants detected in groundwater samples collected in November 1995 and March 1996, respectively.

TCL Pesticides/PCBs: The pesticides 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT, were detected in all groundwater samples at concentrations greater than the State drinking water standard, which is non-detect. The highest concentration detected was from the second round groundwater sample from well MW-01 (4,4'-DDT at 11 micrograms per liter [$\mu\text{g/L}$]). A comparison of Figures 6-25 and 6-26 shows a decrease in concentrations of pesticides in the samples collected from all wells, with the exception of MW-01, which showed an increase in pesticide concentrations between sampling rounds. These figures also illustrate the fact that pesticide concentrations in groundwater are generally an order of magnitude less in samples collected from monitoring wells located downgradient of Site 1 (MW-09 and MW-10) than wells located closer to Site 2 (SW-2 and SW-3). Endrin and alpha-chlordane, both detected below their respective drinking water standards, were the only other pesticides detected in groundwater samples. Neither of these compounds were detected during the analysis of groundwater samples collected during the second round of groundwater sampling.

TCL VOCs: Groundwater samples from both sampling rounds contained low concentrations of VOCs, in the single to double digit $\mu\text{g/L}$ range. The only compounds detected above their respective drinking water standards were ethylbenzene and vinyl chloride. Ethylbenzene was detected in the sample and duplicate from well SW-02 during both sampling rounds at concentrations ranging from 15 $\mu\text{g/L}$ to 22 $\mu\text{g/L}$, exceeding the State drinking water standard of 5 $\mu\text{g/L}$. It should be noted, however, that the Federal Maximum Contaminant Level (MCL) for ethylbenzene is 700 $\mu\text{g/L}$, more than 30 times greater than the highest concentration of ethylbenzene detected during the RI.

Vinyl chloride was detected in samples from well JMW-109 during both sampling rounds and in the sample from MW-09 during the first round only. The only exceedance of the Federal MCL and State drinking water standard of 2 $\mu\text{g/L}$ was from JMW-109 (7 $\mu\text{g/L}$) during the first round. Both of these wells are located downgradient of Site 1, the Former Base Landfill. Vinyl chloride was not detected in any wells upgradient of Site 1.

TABLE 6-16
SITE 2 GROUNDWATER ANALYSIS SUMMARY - NOVEMBER 1995
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	MCL ¹	NEW YORK DWQS ²	SAMPLE NUMBER									
				MW-01-1128		SW-02-1128		SW-12-1128		SW-03-1128		MW-09-1127	
VOCs (µg/L)													
1,1-Dichloroethane	10	7	5	10	U	10	UJ	10	UJ	10	UJ	2	
2-Butanone	10	NA	NA	10	U	10	UJ	10	UJ	10	UJ	3	
2-Hexanone	10	NA	NA	10	R	10	R	10	R	10	R	3	J
Carbon Disulfide	10	NA	NA	1		10	UJ	10	UJ	10	UJ	10	U
Chloroethane	10	NA	NA	10	U	10	UJ	10	UJ	10	UJ	2	J
Chloroform	10	80	7	4		10	UJ	10	UJ	10	UJ	10	U
Ethylbenzene	10	700	5	10	U	15	J	17	J	10	UJ	10	U
Trichloroethene	10	5	5	4		10	UJ	10	UJ	10	UJ	10	U
Vinyl Chloride	10	2	2	10	U	10	UJ	10	UJ	10	UJ	2	
SVOCs (µg/L)													
2-Methylnaphthalene	10	NA	NA	10	U	25	J	41	J	10	U	10	U
2,4-Dichlorophenol	10	NA	1	10	U	7		9		10	U	10	U
Bis(2-ethylhexyl)phthalate	10	NA	50	77		10	U	10	U	10	U	14	U
Dibenzofuran	10	NA	NA	10	U	2		2		10	U	10	U
Diethylphthalate	10	NA	NA	10	U	10	U	10	U	10	U	10	U
Diphenylphthalate	10	NA	NA	10	U	10	U	10	U	10	U	10	U
Fluorene	10	NA	NA	10	U	1		1		10	U	10	U
Naphthalene	10	NA	NA	10	U	37	J	72	J	10	U	10	U
Phenol	10	NA	1	10	U	2		7		10	U	10	U
PEST/PCBs (µg/L)													
4,4'-DDD	0.1	NA	ND	1.3	J	4.6	J	7.1	J	1.4	J	6.01	J
4,4'-DDE	0.1	NA	ND	0.14	J	0.78	J	0.79	J	0.1	UJ	0.1	U
4,4'-DDT	0.1	NA	ND	3.2	J	4.6	J	8.4	J	6.4	J	0.52	J
alpha-Chlordane	0.05	2	0.1	0.007		0.017	R	0.05	U	0.05	UJ	0.05	U
Endrin	0.1	2	ND	0.1	UJ	0.1	UJ	0.11	R	0.039	J	0.1	UJ
DISSOLVED METALS (µg/L)													
Aluminum	200	NA	NA	305		19.3	U	119		78.3		191	
Antimony	60	6	NA	23.4	U	28.3		23.4	U	23.4	U	25.4	
Arsenic	10	50	25	11.7		1.2	U	2.7		1.2	U	1.2	U
Barium	200	2,000	1,000	12.7		18		20.3		18.3		62.2	
Cadmium	5	5	NA	2.7	U	2.8		3.2		2.7	U	2.7	U
Calcium	5,000	NA	NA	38,500		188,000		189,000		157,000		187,000	
Chromium	10	100	50	10.7		10.3	UJ	10.3	UJ	10.3	UJ	10.3	U
Copper	25	1,300	200	4.8		4.2		7.2		6.9		4.8	
Iron	1,000	NA	300	81		195		298		59.5		381	
Lead	3	15	25	0.58		1.3		1.4		2		1.4	
Magnesium	5,000	NA	NA	2,450		44,800		43,400		32,800		24,700	
Manganese	15	NA	300	13.9		3,080		3,000		1,110		1,830	
Nickel	0.2	100	NA	14.1	U	14.1	U	14.1	U	14.1	U	34.7	
Potassium	5,000	NA	NA	1,860		1,970		2,140		2,330		3,740	
Silver	10	NA	50	2.1	U	5.7	J	7.2	J	5.3	J	2.1	U
Sodium	5,000	NA	20,000	54,100		17,200		16,800		12,700		132,000	
Vanadium	50	NA	NA	24.9		7.4		11.5		11.5		3.4	U
Zinc	20	NA	300	292	J	52.2	J	206	R	117	J	365	J
TOTAL METALS (µg/L)													
Aluminum	200	NA	NA	8,200		1,230		797		9,420		5,170	
Antimony	60	6	NA	23.4	U	42.7		23.4	U	23.8		30	
Arsenic	10	50	25	15.9		3		2.5		4.8		3.2	
Barium	200	2,000	1,000	67		25.2		29.5		57.2		93.7	
Cadmium	5	5	NA	2.7	U	2.7	U	2.7	U	2.7	U	4.8	
Calcium	5,000	NA	NA	83,800		189,000		183,000		173,000		183,000	
Chromium	10	100	50	23.6		10.3	UJ	10.3	UJ	17.2	J	10.3	U
Cobalt	50	NA	NA	10		7.1	U	7.1	U	10.1		9.1	
Copper	25	1,300	200	21.4		7		5.7		29.7	J	24.8	
Iron	1,000	NA	300	12,000		2,160		1,320		17,900		9,450	
Lead	3	15	25	9		3		2.9		10.9		8.4	
Magnesium	5,000	NA	NA	8,110		43,500		43,000		37,900		27,100	
Manganese	15	NA	300	328		3,000		3,040		1,580		2,060	
Mercury	0.2	2	2	0.2	U	0.2	U	0.2	U	0.2	U	0.23	
Nickel	40	100	NA	14.3		14.1		14.1		29.8		43.6	
Potassium	5,000	NA	NA	2,930		2,320		2,120		4,380		5,150	J
Silver	10	NA	50	2.1	U	5.4	J	4.3	J	5	J	3.8	J
Sodium	5,000	NA	20,000	53,500		16,500		16,500		13,000		125,000	J
Thallium	10	2	NA	1.3	J	1.2	UJ	1.2	UJ	1.3	J	1.2	U
Vanadium	50	NA	NA	43.9		10.7		15		37.4		20.9	
Zinc	20	NA	300	225	J	194	J	96.8	R	265	J	273	J
Cyanide	10	200	100	32		10	U	10	U	10	U	10	U

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
 4,4'-DDE - Dichlorodiphenyldichloroethylene
 4,4'-DDT - Dichlorodiphenyltrichloroethane
 DWQS - Drinking Water Quality Standard
 MCL - Maximum Contaminant Level
 ND - Not Detected
 NYSDEC - New York State Department of Environmental Conservation
 PEST/PCBs - Pesticides/Polychlorinated Biphenyls
 SVOCs - Semi-Volatile Organic Compounds
 VOCs - Volatile Organic Compounds
 µg/L - micrograms per liter

DATA QUALIFIERS

J - Estimated Value
 R - Rejected Value
 U - Below Detection Limits

NOTES

- Detection Limits - Contract Required Detection Limits for Organics
 - Contract Required Quantitation Limits for Inorganics
 - U.S. EPA Drinking Water Regulations and Health Advisories EPA 822-R-001, May 1994.
 - NYSDEC Water Quality Standards and Guidance Values, November 1991.
- 795 - Indicates concentration that exceeds either State or Federal regulatory limits.

TABLE 6-16 (cont.)
SITE 2 GROUNDWATER ANALYSIS SUMMARY - NOVEMBER 1995
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	MCL ¹	NEW YORK DWQS ²	SAMPLE NUMBER							
				MW-10-1128		JMW-108-1128		JMW-109-1128		MW-13-1128	
VOCs (µg/L)											
1,1-Dichloroethane	10	7	5	10	U	10	U	2		10	U
2-Butanone	10	NA	NA	10	U	10	U	10	U	10	U
2-Hexanone	10	NA	NA	10	R	10	R	10	R	10	R
Carbon Disulfide	10	NA	NA	10	U	10	U	10	U	10	U
Chloroethane	10	NA	NA	10	U	10	U	2		10	U
Chloroform	10	80	7	10	U	10	U	3		10	U
Ethylbenzene	10	700	5	10	U	10	U	10	U	10	U
Trichloroethene	10	5	5	10	U	10	U	10	U	10	U
Vinyl Chloride	10	2	2	10	U	10	U	7		10	U
SVOCs (µg/L)											
2-Methylnaphthalene	10	NA	NA	10	U	10	U	10	U	4	
2,4-Dichlorophenol	10	NA	1	10	U	10	U	10	U	10	U
Bis(2-ethylhexyl)phthalate	10	NA	50	10	U	10	U	10	U	10	U
Dibenzofuran	10	NA	NA	10	U	10	U	10	U	10	U
Diethylphthalate	10	NA	NA	10	U	10	U	10	U	1	
Di-n-butylphthalate	10	NA	NA	10	U	10	U	10	U	1	
Fluorene	10	NA	NA	10	U	10	U	10	U	10	U
Naphthalene	10	NA	NA	10	U	10	U	10	U	10	U
Phenol	10	NA	1	10	U	10	U	10	U	10	U
PEST/PCBs (µg/L)											
4,4'-DDD	0.1	NA	ND	0.089	J	0.027	J	0.013	J	0.31	J
4,4'-DDE	0.1	NA	ND	0.1	U	0.1	U	0.1	U	0.1	U
4,4'-DDT	0.1	NA	ND	0.22		0.13		0.098		0.58	
alpha-Chlordane	0.05	2	0.1	0.05	U	0.05	U	0.05	U	0.05	U
Endrin	0.1	2	ND	0.1	UJ	0.1	UJ	0.1	UJ	0.1	UJ
DISSOLVED METALS (µg/L)											
Aluminum	200	NA	NA	25.7		44.9		69		19.3	U
Antimony	60	6	NA	23.4	U	23.4	U	23.4	U	23.4	U
Arsenic	10	50	25	1.4		1.6		1.2	U	8.1	
Barium	200	2,000	1,000	36.8		46.6		19.4		228	J
Cadmium	5	5	NA	2.7	U	2.7	U	2.7	U	2.7	U
Calcium	5,000	NA	NA	96,000		141,000		101,000		172,000	
Chromium	10	100	50	10.3	U	10.3	U	10.3	U	10.3	U
Copper	25	1,300	200	5.8		3.4		4.5		4.2	
Iron	1000	NA	300	82.5		28		102		4,820	
Lead	3	15	25	1.2		0.11	U	0.47		0.33	
Magnesium	5,000	NA	NA	13,500		16,900		12,100		30,100	
Manganese	15	NA	300	61.5		22.7		1140	J	732	
Nickel	0.2	100	NA	14.1	U	14.1	U	14.1	U	14.1	U
Potassium	5000	NA	NA	984		1,730		1,320		7,750	J
Silver	10	NA	50	2.1	U	2.1	U	2.1	U	3.9	J
Sodium	5000	NA	20,000	128,000		62,400		16,200	J	12,900	
Vanadium	50	NA	NA	3.4	U	5.2		3.4	U	11.2	
Zinc	20	NA	300	60.5	J	130	J	115	J	42.4	J
TOTAL METALS (µg/L)											
Aluminum	200	NA	NA	5,020		1,020		454		11,500	
Antimony	60	6	NA	23.4	U	23.4	U	23.4	U	24	
Arsenic	10	50	25	3.9		2		2.3		16.1	
Barium	200	2,000	1,000	68.4		53.2		21.8		289	J
Cadmium	5	5	NA	2.7	U	2.7	U	2.7	U	3.1	
Calcium	5,000	NA	NA	10,100		14,100		10,400		211,000	
Chromium	10	100	50	10.3	U	10.3	U	10.3	U	22.1	J
Cobalt	50	NA	NA	7.1	U	7.1	U	7.2		18.2	
Copper	25	1,300	200	14.3		17.8		6.4		41.1	J
Iron	1,000	NA	300	9,460		2,000		745		32,600	
Lead	3	15	25	4.4		2.1		0.11	U	14.3	
Magnesium	5,000	NA	NA	15,600		17,200		12,000		37,400	
Manganese	15	NA	300	426		57.5		928	J	1,540	
Mercury	0.2	2	2	0.2	U	0.2	U	0.2	U	0.2	U
Nickel	40	100	NA	14.1		14.1	U	14.1	U	36.7	
Potassium	5,000	NA	NA	1,880		2,010		1,430		8,400	J
Silver	10	NA	50	2.1	U	2.1	U	2.1	U	5.4	J
Sodium	5,000	NA	20,000	133,000		62,400		14,700	J	12,400	
Thallium	10	2	NA	1.2	U	1.2	U	1.2	U	1.2	U
Vanadium	50	NA	NA	17.2		6		3.4	U	47.7	
Zinc	20	NA	300	795	J	90.6	J	208	J	139	J
Cyanide	10	200	100	12		10	U	30		10	U

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
 4,4'-DDE - Dichlorodiphenyldichloroethylene
 4,4'-DDT - Dichlorodiphenyltrichloroethane
 DWQS - Drinking Water Quality Standard
 MCL - Maximum Contaminant Level
 ND - Not Detected
 NYSDEC - New York State Department of Environmental Conservation
 PEST/PCBs - Pesticides/Polychlorinated Biphenyls
 SVOCs - Semi-Volatile Organic Compounds
 VOCs - Volatile Organic Compounds
 µg/L - micrograms per liter

DATA QUALIFIERS

J - Estimated Value
 R - Rejected Value
 U - Below Detection Limits

NOTES

- Detection Limits - Contract Required Detection Limits for Organics
 - Contract Required Quantitation Limits for Inorganics
- U.S. EPA Drinking Water Regulations and Health Advisories
 EPA 822-R-001, May 1994.
- NYSDEC Water Quality Standards and Guidance Values, November 1991.

795 - Indicates concentration that exceeds either State or Federal regulatory limits.

TABLE 6-17
SITE 2 GROUNDWATER ANALYSIS SUMMARY - MARCH 1996
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	MCL ²	NEW YORK DWQS ³	SAMPLE NUMBER									
				MW-01-0320		SW-02-0320		SW-12-0320		SW-03-0321		MW-09-0321	
VOCs (µg/L)													
1,1-Dichloroethane	10	NA	5	10	U	10	U	10	U	10	U	2	
1,2-Dichloroethane (total)	10	70	5	10	U	10	U	10	U	10	U	10	U
2-Hexanone	10	NA	NA	10	U	10	U	10	U	10	U	10	U
4-Methyl-2-Pentanone	10	NA	NA	10	U	10	U	10	U	10	U	10	U
Acetone	10	NA	NA	5	J	4	J	10	UJ	10	UJ	10	UJ
Chloroform	10	80	7	1		10	U	10	U	10	U	10	U
Chloromethane	10	NA	NA	10	U	10	U	10	U	10	U	2	
Ethylbenzene	10	700	5	10	U	22		22		10	U	10	U
Vinyl Chloride	10	2	2	10	U	10	U	10	U	10	U	10	U
Total Xylenes	10	10000	5	10	U	1		1		10	U	10	U
SVOCs (µg/L)													
2-Methylnaphthalene	10	NA	NA	10	U	2		2		10	U	10	U
2,4-Dichlorophenol	10	NA	1	10	U	7		8		10	U	10	U
Dibenzofuran	10	NA	NA	10	U	1		1		10	U	10	U
Di-n-octylphthalate	10	NA	NA	3		10	U	10	U	10	U	10	U
Fluorene	10	NA	NA	10	U	10	U	1		10	U	10	U
Naphthalene	10	NA	NA	10	U	39		45		10	U	10	U
PEST/PCBs (µg/L)													
4,4'-DDD	0.1	NA	ND	4.4	J	4.5	J	9.7	J	0.49	J	0.038	J
4,4'-DDE	0.1	NA	ND	0.54	J	0.26	J	0.44		0.006		0.1	U
4,4'-DDT	0.1	NA	ND	11	J	1.7	J	4.1		0.28		0.12	
DISSOLVED METALS (µg/L)													
Aluminum	200	NA	NA	38.3		23.1	U	29.6		92.2		31.5	
Arsenic	10	50	25	3.5	J	1.7	U	1.7	U	1.7	U	1.7	U
Barium	200	2,000	1,000	18.4		14.4		15.3		12		115	
Beryllium	5	4	NA	1	U	1	U	1	U	1	U	1	U
Cadmium	5	5	NA	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Calcium	5,000	NA	NA	36,900		178,000		184,000		173,000		175,000	
Chromium	10	100	50	10.1	U	10.1	U	10.1	U	10.1	U	10.1	U
Cobalt	50	NA	NA	7.2	U	7.2	U	7.2	U	7.2	U	7.2	U
Copper	25	1,300	200	6.8		5.4		5.1	U	9.3	J	5.8	
Iron	1,000	NA	300	33.9		261		205		99		37.5	
Lead	3	15	25	1.1	U	1.1	U	1.1	UJ	1.1	UJ	1.1	U
Magnesium	5,000	NA	NA	5,500		41,900		42,700		35,300		24,600	
Manganese	15	NA	300	35.8		3,080		3,140		1,210		738	
Mercury	0.2	2	2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Nickel	40	100	NA	12.6	U	12.6	U	12.6	U	12.6	U	17.5	
Potassium	5,000	NA	NA	1,420		1,620		1,670		2,390		1,760	
Selenium	5	50	10	2.4	J	8.3	UJ	8.3	UJ	1.7	UJ	1.7	UJ
Sodium	5,000	NA	20,000	58,200		17,000		16,800		13,700		113,800	
Vanadium	50	NA	NA	7.2		6.4	U	6.4	U	6.4	U	6.4	U
Zinc	20	NA	300	77.7	J	13.4	J	25.9	J	169	J	107	R
TOTAL METALS (µg/L)													
Aluminum	200	NA	NA	3,370		314		449		524		80.8	
Arsenic	10	50	25	5		1.7	U	1.7	U	1.7	U	1.7	U
Barium	200	2,000	1,000	41.9		18.8		20.6		11.8		115	
Beryllium	5	4	NA	1	U	1	U	1	U	1	U	1	U
Cadmium	5	5	NA	3.3	U	3.3	U	3.3	U	3.3	U	3.3	U
Calcium	5,000	NA	NA	48,600		179,000		182,000		171,000		182,000	
Chromium	10	100	50	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ	10.1	UJ
Cobalt	50	NA	NA	7.2	U	7.2	U	7.2	U	7.2	U	7.2	U
Copper	25	1,300	200	14.5		6.3		5.1	U	7	J	10.5	
Iron	1,000	NA	300	5,200		915		1,060		918		309	
Lead	3	15	25	2.6		1.1	UJ	1.1		1.1	U	1.1	U
Magnesium	5,000	NA	NA	7,220		42,400		42,800		34,500		24,200	
Manganese	15	NA	300	173		3,100		3,110		1,220		793	
Mercury	0.2	2	2	0.2	UJ	0.2	UJ	1	J	0.2	UJ	0.2	UJ
Nickel	40	100	NA	12.6	U	13.4		12.6	U	12.6	U	19.4	
Potassium	5,000	NA	NA	2,230		1,800		1,880		2,280		1,700	
Selenium	5	50	10	1.7	R	1.7	R	1.7	R	1.7	R	1.7	R
Sodium	5,000	NA	20,000	59,700		17,100		17,300		12,700		187,800	
Vanadium	50	NA	NA	16.3		6.4	U	6.4	U	6.4	U	6.4	U
Zinc	20	NA	300	91.9	J	45.9	J	81.9	J	149	J	56.8	R
Cyanide	10	200	100	10	U	10	U	10	U	10	U	10	U

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
 4,4'-DDE - Dichlorodiphenyldichloroethylene
 4,4'-DDT - Dichlorodiphenyltrichloroethane
 DWQS - Drinking Water Quality Standard
 MCL - Maximum Contaminant Level
 ND - Not Detected
 NYSDEC - New York State Department of Environmental Conservation
 PEST/PCBs - Pesticides/Polychlorinated Biphenyls
 SVOCs - Semi-Volatile Organic Compounds
 VOCs - Volatile Organic Compounds
 µg/L - micrograms per liter

DATA QUALIFIERS

J - Estimated Value
 R - Rejected Value

NOTES

- 1) Detection Limits - Contract Required Detection Limits for Organics
 - Contract Required Quantitation Limits for Inorganics
 - 2) U.S.EPA Drinking Water Regulations and Health Advisories EPA 822-R-001, May 1994.
 - 3) NYSDEC Water Quality Standards and Guidance Values, November 1991.
- 324 - Indicates concentration that exceeds either State or Federal regulatory limits.

TABLE 6-17 (cont.)
SITE 2 GROUNDWATER ANALYSIS SUMMARY - MARCH 1996
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS¹	MCL²	NEW YORK DWQS³	SAMPLE NUMBER							
				MW-10-0321		JMW-108-0321		JMW-109-0321		MW-13-0320	
VOCs (µg/L)											
1,1-Dichloroethane	10	7	5	10	U	10	U	10	U	10	U
1,2-Dichloroethene (total)	10	7	5	10	U	10	U	2		10	U
2-Hexanone	10	NA	NA	10	U	1		10	U	10	U
4-Methyl-2-Pentanone	10	NA	NA	10	U	1		10	U	10	U
Acetone	10	NA	NA	10	UJ	5	J	10	UJ	10	UJ
Chloroform	10	80	7	10	U	10	U	10	U	10	U
Chloromethane	10	NA	NA	10	U	2		10	U	10	U
Ethylbenzene	10	700	5	10	U	10	U	10	U	10	U
Vinyl Chloride	10	2	2	10	U	10	U	1		10	U
Total Xylenes	10	10	5	10	U	10	U	10	U	10	U
SVOCs (µg/L)											
2-Methylnaphthalene	10	NA	NA	10	U	10	U	10	U	10	U
2,4-Dichlorophenol	10	NA	1	10	U	10	U	10	U	10	U
Dibenzofuran	10	NA	NA	10	U	10	U	10	U	10	U
Di-n-octylphthalate	10	NA	NA	10	U	10	U	10	U	10	U
Fluorene	10	NA	NA	10	U	10	U	10	U	10	U
Naphthalene	10	NA	NA	10	U	10	U	10	U	1	
PEST/PCBs (µg/L)											
4,4'-DDD	0.1	NA	ND	0.043	J	0.009	J	0.017		0.13	J
4,4'-DDE	0.1	NA	ND	0.1	U	0.1	U	0.1	U	0.006	J
4,4'-DDT	0.1	NA	ND	0.21	J	0.013	J	0.009	J	0.28	J
DISSOLVED METALS (µg/L)											
Aluminum	200	NA	NA	46.7		23.1	U	23.1	U	23.1	U
Arsenic	10	50	25	1.7	U	1.7	U	1.7	U	7.8	
Barium	200	2,000	1,000	29.6		47.3		16.7		185	
Beryllium	5	4	NA	1	U	1	U	1	U	1	U
Cadmium	5	5	NA	3.3	U	3.3	U	3.3	U	3.3	U
Calcium	5,000	NA	NA	99,000		144,000		95,400		176,000	
Chromium	10	100	50	10.1	U	10.1	U	10.1	U	10.1	U
Cobalt	50	NA	NA	7.2	U	7.2	U	7.2	U	7.2	U
Copper	25	1,300	200	8.4		5.1		5.4		7.8	
Iron	1000	NA	300	32.3		41.8		32.6		8,470	
Lead	3	15	25	1.1	U	1.1	U	1.1	U	1.1	U
Magnesium	5,000	NA	NA	14,800		18,400		11,400		33,700	
Manganese	15	NA	300	32.7		31.2		482		635	
Mercury	0.2	2	2	0.2	U	0.2	U	0.2	U	0.2	UJ
Nickel	40	100	NA	12.6	U	12.6	U	12.6	U	12.6	U
Potassium	5000	NA	NA	705		1,620		982		4,670	
Selenium	5	50	10	1.7	UJ	1.7	UJ	1.7	UJ	1.7	UJ
Sodium	5000	NA	20,000	97,900		55,800		13,700		9,180	
Vanadium	50	NA	NA	6.4	U	6.4	U	6.4	U	6.4	U
Zinc	20	NA	300	163	J	38.5	J	25.1	J	25.6	J
TOTAL METALS (µg/L)											
Aluminum	200	NA	NA	40,400		943		68.6		5,700	
Arsenic	10	50	25	20.2		1.7	U	1.7	U	17.7	
Barium	200	2,000	1,000	263		54.4		17.2		216	
Beryllium	5	4	NA	1.4		1	U	1	U	1	U
Cadmium	5	5	NA	7.6		4.5		3.3	U	3.3	U
Calcium	5,000	NA	NA	118,000		158,000		97,400		209,000	
Chromium	10	100	50	55.4	J	10.1	UJ	10.1	UJ	10.1	UJ
Cobalt	50	NA	NA	36.1		7.2	U	7.2	U	7.2	U
Copper	25	1,300	200	96.6		12.6		5.7		32.7	
Iron	1,000	NA	300	80,100		1,810		302		20,700	
Lead	3	15	25	35		1.1	U	1.1	U	11	
Magnesium	5,000	NA	NA	29,000		18,600		12,000		35,800	
Manganese	15	NA	300	3250		71.7		698		1,310	
Mercury	0.2	2	2	0.2	UJ	0.2	UJ	0.2	UJ	0.2	UJ
Nickel	40	100	NA	78.1		16.7		12.6	U	21.6	
Potassium	5,000	NA	NA	5,560		1,790		1,040		5,240	
Selenium	5	50	10	1.7	R	1.7	R	1.7	R	19.9	R
Sodium	5,000	NA	20,000	99,400		51,200		15,400		14,800	
Vanadium	50	NA	NA	99.8		6.4	U	6.4	U	19.2	
Zinc	20	NA	300	324	J	49.9	J	19.5	J	59.9	J
Cyanide	10	200	100	10	U	10	U	10	U	10	U

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
4,4'-DDE - Dichlorodiphenyldichloroethylene
4,4'-DDT - Dichlorodiphenyltrichloroethane
DWQS - Drinking Water Quality Standard
MCL - Maximum Contaminant Level
ND - Not Detected
NYSDEC - New York State Department of Environmental Conservation
PEST/PCBs - Pesticides/Polychlorinated Biphenyls
SVOCs - Semi-Volatile Organic Compounds
VOCs - Volatile Organic Compounds
µg/L - micrograms per liter

DATA QUALIFIERS

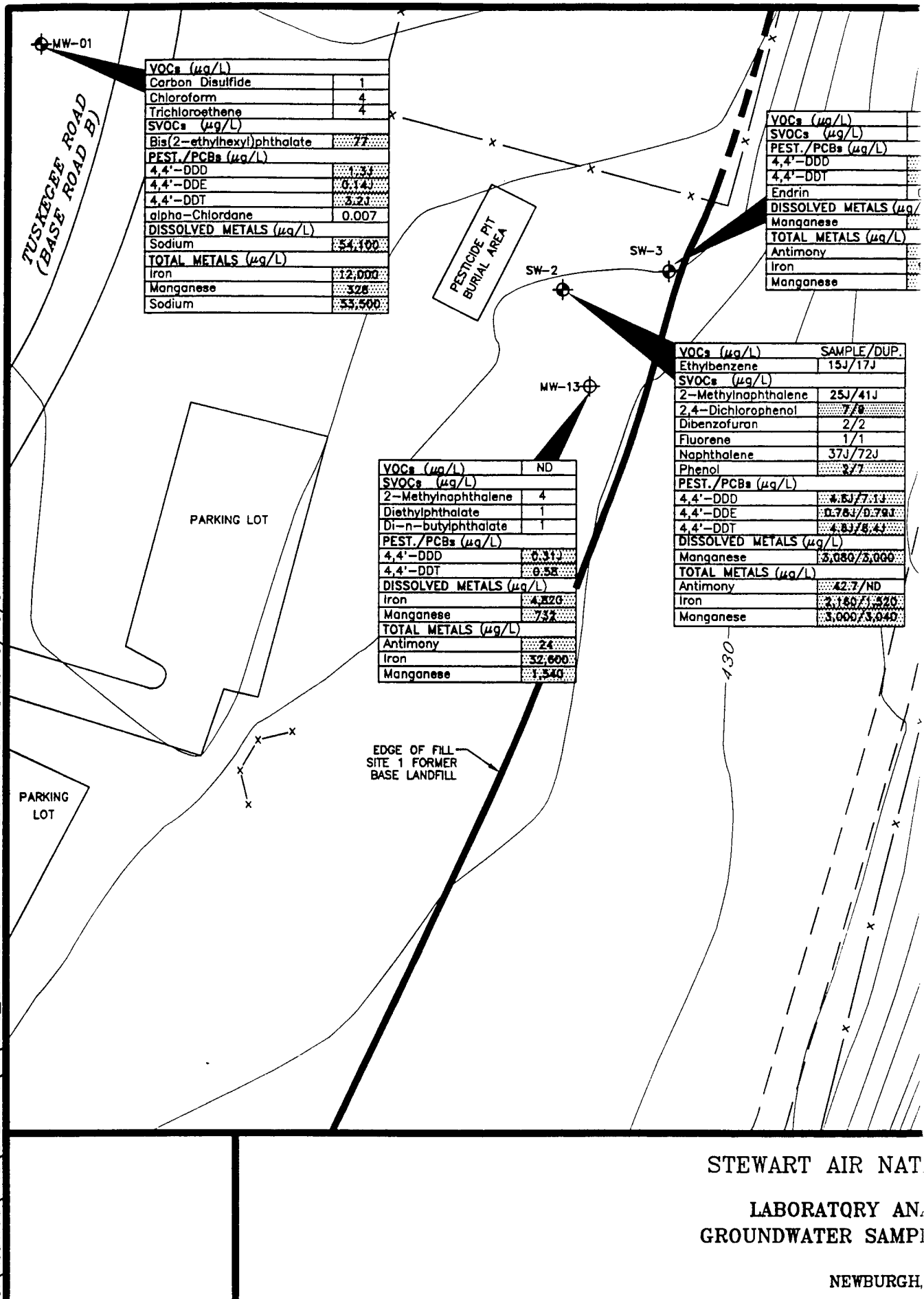
J - Estimated Value
R - Rejected Value

NOTES

- Detection Limit - Contract Required Detection Limits for Organics
- Contract Required Quantitation Limits for Inorganics
 - U.S.EPA Drinking Water Regulations and Health Advisories
EPA 822-R-001, 1994.
 - NYSDEC Water Quality Standards and Guidance Values, November 1991.
- 324 - Indicates concentration that exceeds either State or Federal regulatory limits.

Last Revision Date: 3/19/97

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GROUNDWATER SAMPL

NEWBURGH,

VOCs (µg/L)	ND
SVOCs (µg/L)	ND
PEST./PCBs (µg/L)	
4,4'-DDD	1.4J
4,4'-DDT	5.4J
Endrin	0.039J
DISSOLVED METALS (µg/L)	
Manganese	1,110
TOTAL METALS (µg/L)	
Antimony	23.8
Iron	17,900
Manganese	1,580

VOCs (µg/L)	SAMPLE/DUP.
Ethylbenzene	15J/17J
SVOCs (µg/L)	
2-Methylnaphthalene	25J/41J
2,4-Dichlorophenol	7/8
Dibenzofuran	2/2
Fluorene	1/1
Naphthalene	37J/72J
Phenol	2/7
PEST./PCBs (µg/L)	
4,4'-DDD	4.8J/7.1J
4,4'-DDE	0.78J/0.78J
4,4'-DDT	4.8J/8.4J
DISSOLVED METALS (µg/L)	
Manganese	3,080/3,000
TOTAL METALS (µg/L)	
Antimony	42.7/ND
Iron	2,180/1,520
Manganese	3,000/3,040

POND

EDGE OF FILL
SITE 1 FORMER
BASE LANDFILL

VOCs (µg/L)	
1,1-Dichloroethane	2
Chloroethane	2
Chloroform	3
Vinyl Chloride	7
SVOCs (µg/L)	ND
PEST./PCBs (µg/L)	
4,4'-DDD	0.013J
4,4'-DDT	0.008
DISSOLVED METALS (µg/L)	
Manganese	1,140J
TOTAL METALS (µg/L)	
Iron	745
Manganese	925J

VOCs (µg/L)	
SVOCs (µg/L)	
PEST./PCBs (µg/L)	
4,4'-DDD	0
4,4'-DDT	0
DISSOLVED METALS (µg/L)	
Sodium	12
TOTAL METALS (µg/L)	
Iron	9
Manganese	4
Sodium	13
Zinc	7

VOCs (µg/L)	
1,1-Dichloroethane	2
2-Butanone	3
2-Hexanone	3J
Chloroethane	2J
Vinyl Chloride	2
SVOCs (µg/L)	ND
PEST./PCBs (µg/L)	
4,4'-DDD	0.21J
4,4'-DDT	0.82J
DISSOLVED METALS (µg/L)	
Antimony	25.4
Iron	381
Manganese	1,830
Sodium	152,000
Zinc	305J
TOTAL METALS (µg/L)	
Antimony	80
Iron	9,450
Manganese	2,060
Sodium	125,000

VOCs (µg/L)	ND
SVOCs (µg/L)	ND
PEST./PCBs (µg/L)	
4,4'-DDD	0.027J
4,4'-DDT	0.13
DISSOLVED METALS (µg/L)	
Sodium	62,400
TOTAL METALS (µg/L)	
Iron	2,000
Sodium	62,400

MW-10

MW-09

JMW-108

LEG

JMW

SW

MW

MW

MW

4.5

x

ND

ND

µg/L

25

SCA

FIG

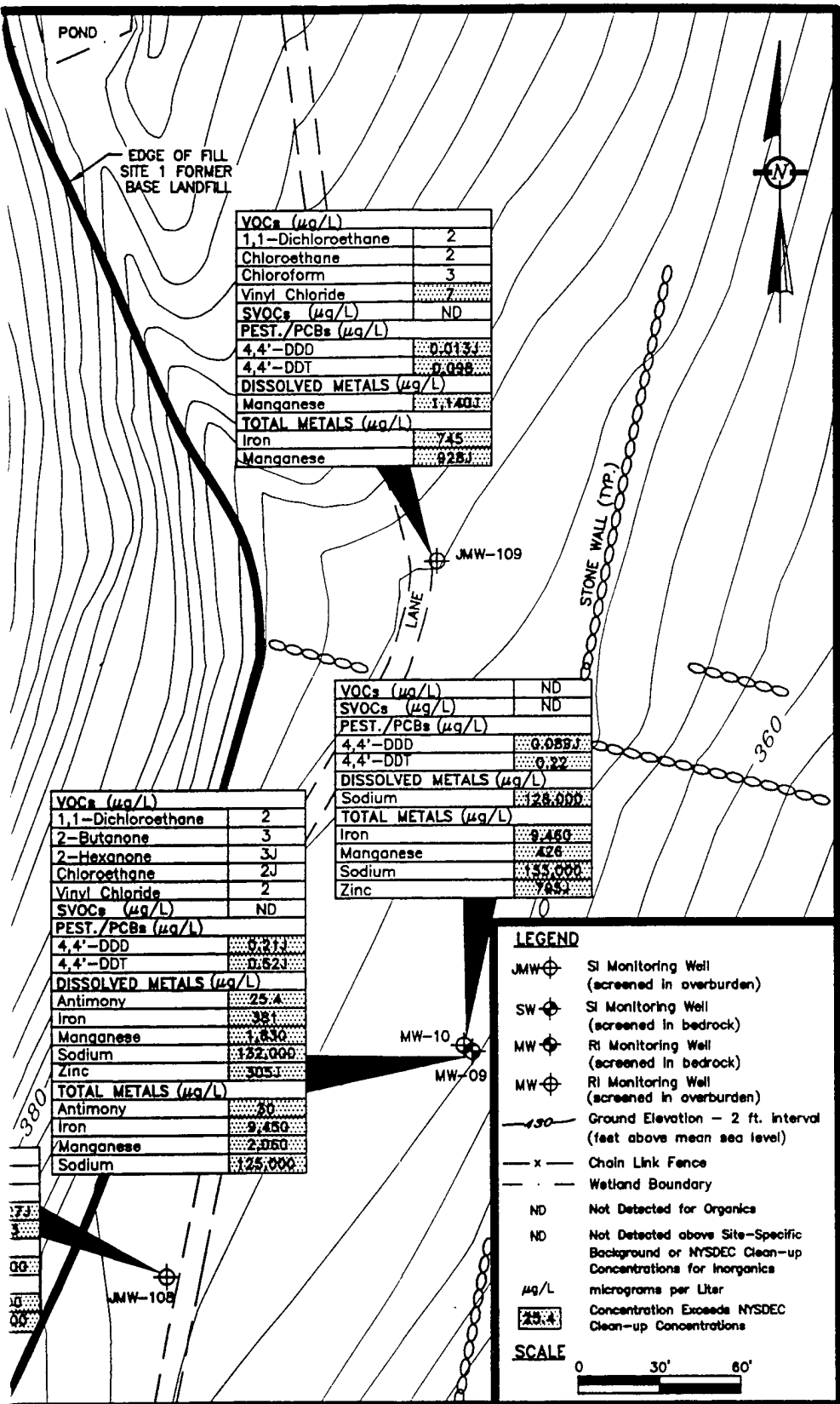
STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS
GROUNDWATER SAMPLES - NOVEMBER 1995

NEWBURGH, NEW YORK

2

6-60

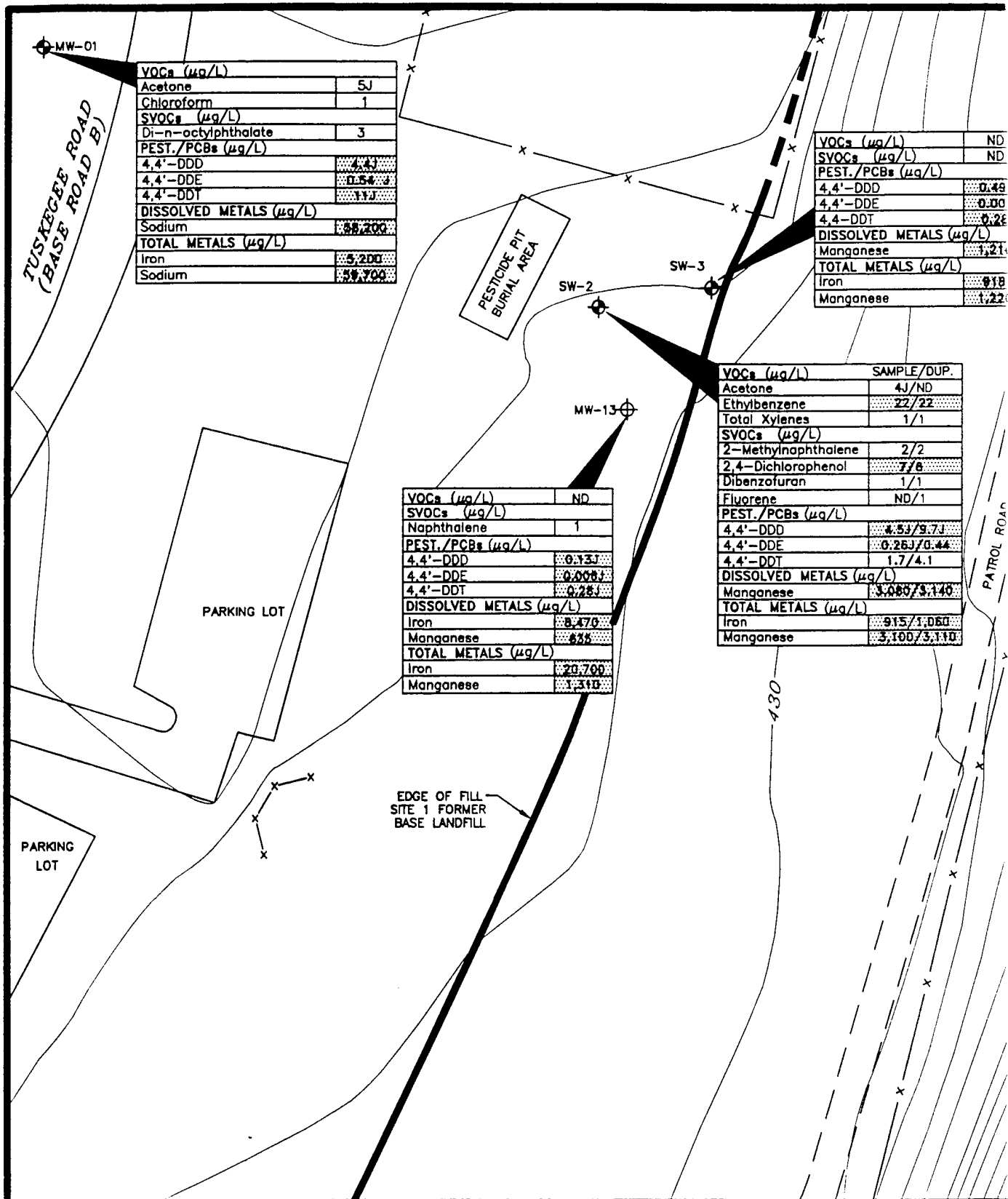


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FIGURE: 6-25

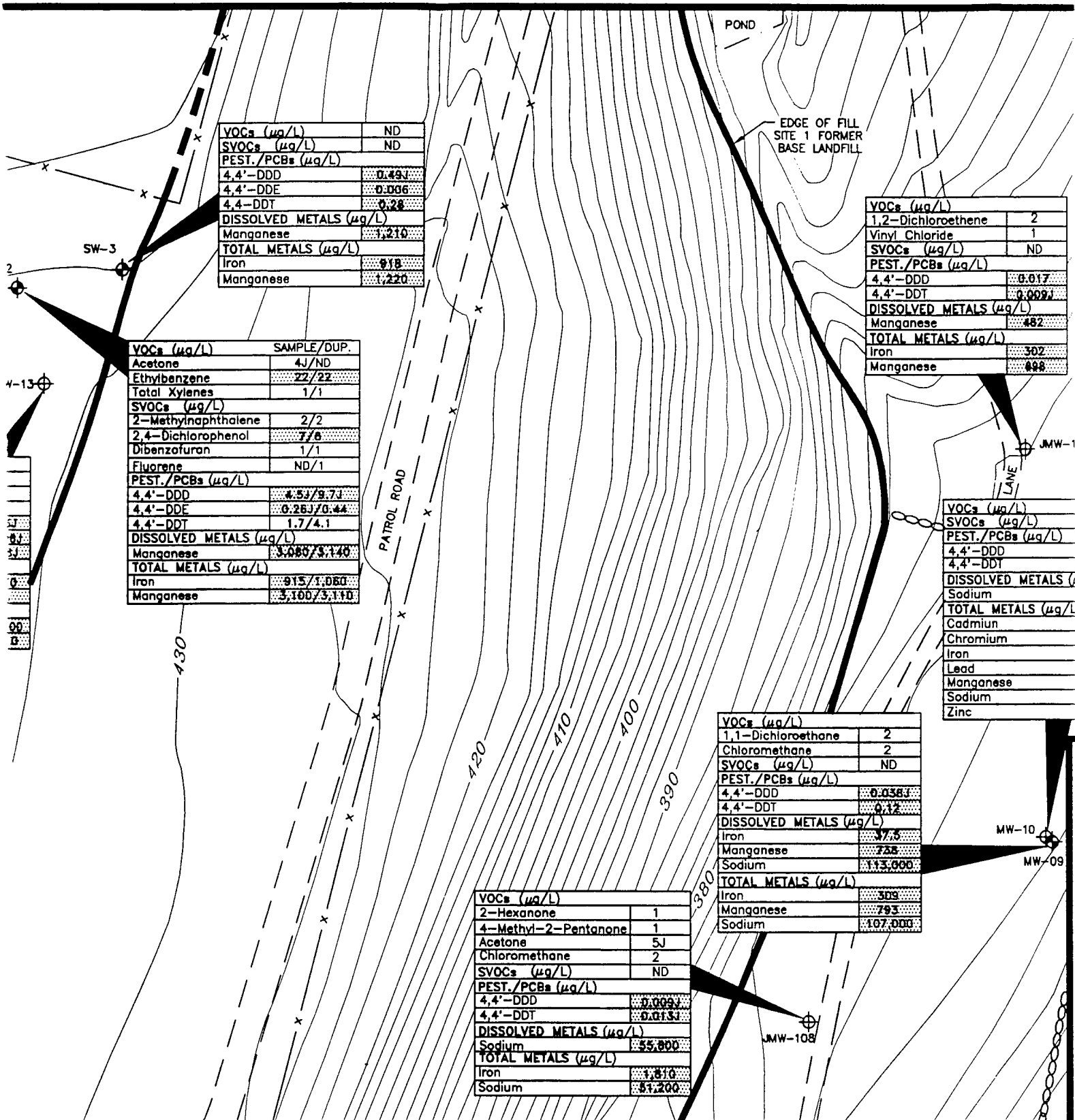
Last Revision Date: 3/19/97

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STEWART AIR NATIONAL AIR FORCE
LABORATORY ANALYSIS
GROUNDWATER SAMPLE

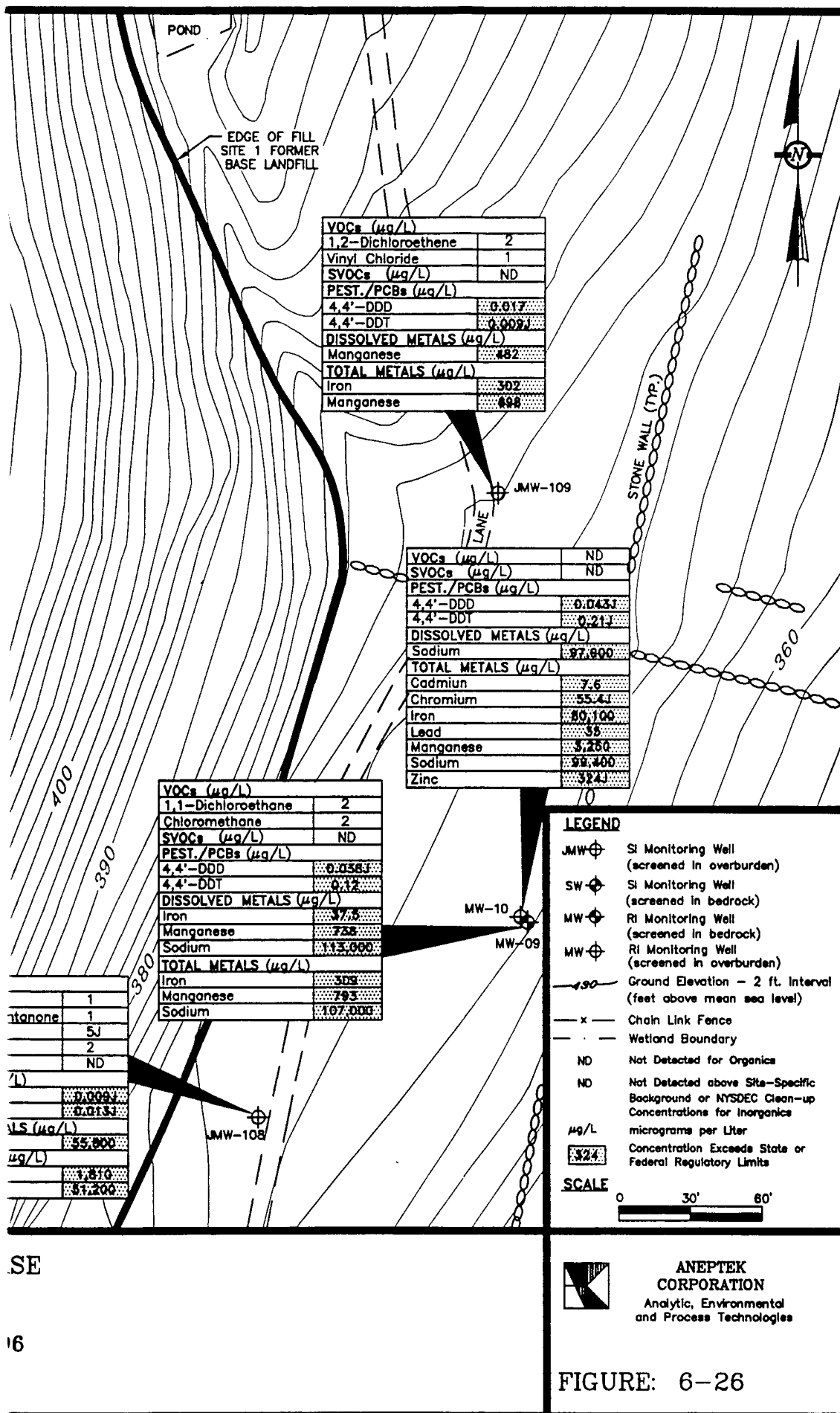
NEWBURGH, NY



STEWART AIR NATIONAL GUARD BASE

LABORATORY ANALYTICAL RESULTS
GROUNDWATER SAMPLES - MARCH 1996

NEWBURGH, NEW YORK



TCL SVOCs: Several fuel-related SVOCs were detected in both samples and duplicates from SW-02. These samples gave off a fuel-like odor during sample collection. SVOCs detected in the first round groundwater sample collected from SW-02 concentrations greater than drinking water standards, include 2,4-dichlorophenol (9 µg/L), and phenol (7 µg/L). Only one SVOC, 2,4-dichlorophenol (8 µg/L), was detected at a concentration greater than drinking water standards in the second round sample collected from SW-02. The only other SVOC detected at a concentration greater than drinking water standards was bis(2-ethylhexyl)phthalate (77 µg/L), in the first round sample collected from MW-01.

TAL Metals: Inorganic analysis was performed on both total (unfiltered) and dissolved (filtered) groundwater samples. Because no site-specific background data is available for groundwater, detected inorganic analytes were only compared to drinking water standards. The inorganic analytes most frequently detected at concentrations greater than drinking water standards were iron, manganese, and sodium. Antimony was detected at levels exceeding the Federal MCL in first round samples from wells SW-02, MW-09, MW-13, and JMW-108, but not from second round samples. Zinc was detected at levels exceeded drinking water standards in first and second round samples from MW-10 and in the first round sample from MW-09. Cadmium, chromium, and lead exceeded drinking water standards in the second round sample from MW-10. With the exception of sodium and manganese, concentrations of inorganics were significantly less in the filtered samples than unfiltered samples. Sodium and manganese concentrations were virtually equal between the filtered and unfiltered samples.

6.4 Summary

6.4.1 Geology and Hydrogeology

1. Site 2 is underlain by an approximately 45 foot thick layer of very dense silty to clayey lodgement glacial till derived from the underlying bedrock, the shallow portion of which has been weathered to less dense soil. Bedrock immediately underlying the till is composed of weathered, fractured, dark grey shale, whose competency increases with depth. The thickness and extent of fracturing varies with location; however, based on one deep core hole, the thickness is estimated to be approximately 22 feet. A north-south trending fault zone east of Site 2 is interpreted from the geologic data, near the bottom of the steep slope near Murphy's Gulch.
2. In general, groundwater flow in the study area can be separated into two interconnected flow systems, an upper flow system in the overburden and a lower system in the underlying weathered, fractured shale bedrock. The lodgement till appears to impede vertical flow, especially beneath Site 2, where the unweathered portion of the till is very thick (greater than 20 feet).
3. Groundwater flows in both the overburden and bedrock to the east or east-southeast towards lower topographic elevations. In the overburden, groundwater flow lines originating from the vicinity of Site 2 terminate in the vicinity of Murphy's Gulch. In

the bedrock, a southeastern component of flow is interpreted in the southern portion of the study area that is not observed in the overburden. The data indicate that a component of flow in the bedrock that originates from Site 2 could flow to the southern portion of the study area. In addition, radial flow indicated by in the bedrock groundwater elevations in the vicinity of Site 2 was observed, possibly induced by less dense backfill and surface runoff detention in the PPBA which results in locally increased infiltration, causing a localized "mounding" condition.

4. In most cases, vertical gradients in well pairs were strongly downward (0.1 to 0.01 magnitude) in the vicinity of Site 2 and at higher elevations elsewhere in the study area. Gradients remain downwards in well clusters in the eastern portion of the study area that are located more than 140 feet west of the wetlands boundary. Strongly upward gradients (0.1 to 0.01 magnitude) were observed only at well pairs in the vicinity of the wetlands west of Murphy's Gulch in the southern portion of the study area. Vertical gradients of lesser magnitude were observed in JTB-103 and JTB-107, but were not observed during every water level measurement round. Both vertical and horizontal hydraulic gradients exhibited a similar range of values.
5. In the overburden, hydraulic conductivity values range from 0.06 to 1.88 ft/d (2.27×10^{-5} cm/sec to 6.64×10^{-4} cm/sec) with a geometric mean value of 0.35 ft/d (1.23×10^{-4} cm/sec). In the fractured bedrock, hydraulic conductivity values range from 0.06 to 1.78 ft/d (2.27×10^{-5} cm/sec to 6.29×10^{-4} cm/sec) with a geometric mean value of 0.22 ft/d (7.84×10^{-5} cm/sec). Although hydraulic conductivity values vary throughout the study area, overburden geometric mean hydraulic conductivity values are only slightly higher than bedrock geometric mean hydraulic conductivity. Vertical hydraulic conductivity was not measured in the till overburden; however, because lodgement till is deposited under conditions of very high pressure induced by the overlying glacier ice, vertical hydraulic conductivity values one to two orders of magnitude less than horizontal hydraulic conductivity could be expected in the till.
6. Effective porosity in the overburden is estimated at 1 to 10 percent, based on grain-size data from the SI. In bedrock, effective porosity is estimated at 1 to 8 percent, based on fracture density and estimates of fracture aperture width observed in rock cores.
7. In the overburden, average horizontal linear or seepage velocity estimates range from 0.21 to 0.64 ft/d. In the bedrock, estimates range from 0.30 to 2.42 ft/d. The relatively high average horizontal linear velocity estimates are due to both the high horizontal gradient and the relatively low formation effective porosity. Because vertical hydraulic conductivity may lower than horizontal hydraulic conductivity by one to two orders of magnitude, corresponding average vertical linear velocity would be correspondingly lower, since both vertical and horizontal hydraulic gradients exhibited similar values.

6.4.2 Nature and Extent

1. Surface soils were generally free of significant contamination. The only parameters exceeding site background or NYSDEC Cleanup Goals were manganese and chromium. No surface soil samples contained pesticide concentrations greater than their respective NYSDEC Cleanup Goals.
2. The lateral extent of residual pesticide contamination within subsurface soils has been well defined to the north, south, and west of the PPBA. East of the PPBA, onsite screening data indicated higher concentrations of pesticides in subsurface soils than the other sides. Screening results were similar to subsurface soil samples submitted for offsite laboratory analysis, with the highest concentrations of 4,4'-DDD and 4,4'-DDT found in sample MW-02-17. The bulk of residual subsurface soil contamination appears to be present approximately 15 to 25 feet bgs in the vicinity of soil boring MW-02.
3. Several inorganic analytes were detected at concentrations greater than their respective background or NYSDEC Cleanup Goals. The majority of these detections were found at the overburden/bedrock interface in soil borings SB-06 and MW-02. No discernible pattern of elevated concentrations of inorganic analytes was found in subsurface soils.
4. Every sediment sample contained low levels of pesticides. Exceedances of NYSDEC Cleanup Goals were found only in samples SS-04 and SS-06, in the vicinity of the ponded area. Inorganic analytes exceeding NYSDEC Cleanup Goals were found in several samples, but the highest levels were found in SS-05, located within the ponded area.
5. Groundwater in the vicinity of Site 2 is generally free of significant VOC and SVOC contamination. However, pesticides were detected in all groundwater samples, thus exceeding the State drinking water pesticide standard which requires the presence of no detectable level. Therefore, the full extent of pesticide contamination in groundwater has not been defined. To the east of Site 2, groundwater pesticide concentrations decreased by an order of magnitude over a distance of approximately 540 feet, from SW-2 to MW-09. To the west, the only well is MW-01. In addition, several inorganic parameters were detected at concentrations greater than drinking water standards. However, due to the absence of site-specific background data for inorganics, it is not possible to determine if these detections are actually elevated or if they are representative of site background concentrations.

SECTION 7.0

7.0 CONTAMINANT FATE AND TRANSPORT

Sections 7.1 and 7.2 provide a brief review of the major contaminant fate and transport properties and processes that influence the mobility of environmental contaminants in soil and groundwater. Sections 7.3 and 7.4 apply these principles to organic and inorganic chemicals, respectively, that were identified in the various media in the Site 2 study area. Only those contaminants above action levels are discussed. Section 7.5 discusses migration pathways and Section 7.6 provides a summary of findings.

7.1 Chemical Processes Influencing Contaminant Fate and Transport

When released into the environment, most organic chemicals undergo a variety of reactions or processes that affect their transport potential and final fate. These processes may include:

- Solution;
- Volatilization, which is related to a compound's Henry's Law Constant (H);
- Sorption, which is evaluated by a compound's organic carbon partition coefficient (K_{oc}), and the calculated soil/water distribution coefficient (K_d);
- Oxidation-reduction;
- Hydrolysis; and
- Biodegradation.

These parameters can be used to estimate a relative quantity of contaminant partitioning into the air, water, and soil. The processes thought to be important at this site include solution, sorption and to a lesser extent, biodegradation.

7.1.1 Solution

Solution is the partitioning of a chemical between the non-aqueous and dissolved phases. The degree to which a compound is soluble (i.e., solubility) is a function of various factors, including salinity, temperature, dissolved organic carbon, oxidation state, polarity, and other factors. Solubility of organic compounds varies from sparingly soluble to infinitely soluble (Fetter, 1993). Compounds that are considered to be very water soluble generally have water solubilities greater than 1,000 milligrams per liter (mg/L). Compounds that are considered to have moderate water solubilities have solubilities between 100 and 1,000 mg/L. Low water solubilities are generally less than 100 mg/L. Knox et al. (1993) indicate that a water solubility of greater than 30 mg/L is the threshold above which pesticides have the potential to leach to groundwater. Although thresholds have not been determined for other organic compounds, water solubilities greater than 30 to 100 mg/L may serve as a general rule for identifying a potential for leachability to subsurface environments.

This discussion does not address solubility of contaminants in other solvents (such as organo-

chlorine pesticides in carrier solvents), only potential fate and transport processes once the contaminant is in the environment. The latter issue is addressed in Section 7.3.

7.1.2 Sorption

Sorption is defined as the interaction of an organic or inorganic contaminant with a solid (Fetter, 1993). Sorption processes can be classified as adsorption (adhesion to the solid's surface) and absorption (penetration into the solid).

Adsorption is defined as the interaction of a solute with sorption sites on a solid surface and is a function of various properties of the compounds of concern and the nature of the aqueous and solid media. Contaminant properties that influence sorption include water solubility, polar/ionic character, octanol/water partition coefficient, acid/base chemistry, and oxidation/reduction chemistry (the last being important for inorganics).

Adsorption mechanisms are typically the dominant processes causing retention of organic molecules. Adsorption may be a significant process in the fate and transport of contaminants, because it can retard the transport of an adsorbed species and also can act as a residual source of contamination, thereby extending the period of contamination. Also, transformation reactions, such as volatilization and biodegradation, are affected by the degree of adsorption.

The retardation factor, R , describes the inhibition of contaminant transport because of sorption. R is divided into the average linear velocity estimate to provide an estimate of inhibited flow due to R .

For organic compounds, R is calculated using the soil/water distribution coefficient (K_d), which is a function of the fraction of organic carbon (f_{oc}) multiplied by the organic carbon partition coefficient (K_{oc}). Retardation factors are then calculated based on K_d , ρ (bulk density), and n_c (porosity) using the following equation:

$$R = 1 + \frac{(\rho K_d)}{n_c}$$

Site specific values of K_d , K_{oc} and R are presented in Section 7.3. These values are based on the following assumptions:

- The ρ of the glacial till soil overburden at this site is estimated at 2.1 grams per cubic centimeter (g/cc) (Hatheway, 1980).
- The n_c is estimated at 1 to 10 percent (see Section 6.0).
- The fraction of organic carbon (f_{oc}) of 6.9×10^{-3} (determined from TOC data).

Soil samples were collected and analyzed for TOC. As shown in Table 7-1, the TOC value ranged from 0.19 to 1.17 percent with a geometric mean values of 0.69 percent. This TOC concentration corresponds to a f_{oc} of 6.9×10^{-3} ($0.69 \div 100 = 0.0069$ or 6.9×10^{-3}). According

TABLE 7-1
TOTAL ORGANIC CARBON - SOIL & SEDIMENT SAMPLES
STEWART AIR NATIONAL GUARD BASE - SITE 2
NEWBURGH, NEW YORK

SOIL SAMPLES		SEDIMENT SAMPLES	
SAMPLE DESIGNATION	TOTAL ORGANIC CARBON (%)	SAMNPLE DESIGNATION	TOTAL ORGANIC CARBON (%)
SB-01-02	0.44	SS-01	0.76
SB-01-18.5	0.97	SS-02	1.07
SB-01-32.5	0.82	SS-03	0.15
SB-02-02	0.42	SS-04	1.36
SB-02-06	0.63	SS-05	0.77
SB-02-10	0.79	SS-06	1.72
SB-03-1.3	0.62	SS-07	2.26
SB-03-06	0.79	SS-15	1.21
SB-03-56	0.52	SB-02-02	0.42
SB-03-22	0.69	SB-03-1.3	0.62
SB-04-02	0.78	SB-04-02	0.78
SB-04-06	1.17	SB-05-02	0.65
SB-04-21	0.87	SB-06-02	0.55
SB-05-02	0.65	SB-07-02	0.78
SB-05-06	0.58	MW-01-04	0.94
SB-05-22	0.94		
SB-06-02	0.55		
SB-06-26.5	0.75		
SB-06-34.5	0.19		
SB-07-02	0.78		
SB-07-16	0.82		
SB-07-33	1.1		
SB-17-33	0.64		
MW-01-04	0.94		
MW-01-18	0.86		
MW-01-31.6	0.46		
MW-02-17	0.65		
MW-02-31	0.83		
MW-03-22	0.67		
MW-03-32	0.75		
Mean TOC Value:	0.72	Mean TOC Value:	0.94
Geometric Mean:	0.69	Geometric Mean:	0.79
Standard Deviation:	0.20	Standard Deviation:	0.51

to Nichols and Sulhotra (1992), when f_{oc} is less than 0.1 percent (1×10^{-3}), K_d is often more related to the cation exchange capacity of the formation, also referred to as inorganic sorption. This factor increases with fines content of the soil.

Given that soils in this study area have both a high f_{oc} and a high fines content (SI grain size data indicates fines content ranging from 27 to 55 percent in many soil samples), retardation through both organic or inorganic sorption processes is likely to be a major factor in limiting contaminant transport of organic compounds through the soils in this study area.

Sorption appears to be the dominant chemical process affecting transport for all inorganics. Mechanisms involved in sorption of metals includes cation-exchange, specific adsorption, organic complexation, and co-precipitation. It is frequently difficult to be precise about which mechanisms are occurring in the subsurface environment, because such factors as temperature, pH and Eh can vary substantially from equilibria calculations available in most reference works. While all of the metals are specifically adsorbed, the metals with the greatest tendency for specific adsorption are lead and copper. All metals are also involved in co-precipitation onto iron oxides, manganese oxides, and clays. Lead, copper, and zinc strongly chelate to organics in soils (Alloway, 1990).

7.1.3 Volatilization

Volatilization may be a major transport pathway by which organic compounds are lost from soil or water after exposure to the atmosphere. It is a physical process that depends on the thermodynamic properties of a chemical and the effects of environmental factors. Volatilization is also an important process in shallow vadose zone (unsaturated) soils. The concentration of the volatile compounds in the soil gas is a function of the groundwater concentration and the extent of vapor/solid partitioning. The effect of volatilization generally decreases with depth.

The volatility of organic compounds may generally be classified on the basis of Henry's Law constants (Knox et. al., 1993). The larger the value of the constant, the more volatile the species. Compounds that will be found primarily in the vapor phase include compounds with Henry's constants greater than 5×10^{-3} atmospheres-cubic meter per mole ($\text{atm}\cdot\text{m}^3/\text{mol}$). Compounds that have a tendency to be found primarily in the liquid phase have Henry's Law constants less than 5×10^{-5} $\text{atm}\cdot\text{m}^3/\text{mol}$ (Olsen and Davis 1990a).

7.1.4 Oxidation-Reduction

Oxidation involves the transfer of electrons between two molecules, with the oxidized component losing electrons and the reduced component gaining electrons. In general, substituted aromatic compounds such as ethylbenzene and phenol can be oxidized. Aromatic compounds have oxidation rates an order of magnitude greater than for chlorinated VOCs. Abiotic oxidation of organic compounds in groundwater is extremely limited (Olsen and Davis, 1990). Reduction reactions transfer electrons to a compound. For chlorinated compounds, the result is a less chlorinated compound (such as vinyl chloride from 1,1-dichloroethene).

7.1.5 Hydrolysis

Hydrolysis is the reaction of a compound with water resulting in a new chemical species. Products of hydrolysis may detoxify, transtoxify, or maintain the toxicity of the contaminants. Rates of hydrolysis reactions are commonly described by half-lives and are strongly dependent on pH. Hydrolysis reactions in groundwater are typically too slow to be significant degradation processes.

7.1.6 Biodegradation

Biodegradation is a specific type of biotransformation in which a compound is biologically altered into simpler compounds by microorganisms in the soil and water environment. Microorganisms are capable of catalyzing the degradation of some of the organic to products less toxic than the pollutant (termed "detoxification" reactions) or more toxic (termed "activation" reactions). The most complete biodegradation reaction is termed "mineralization," whereby organic compounds are degraded to carbon dioxide and inorganic products such as nitrate and phosphate (EPA 1985). According to Knox et al. (1993), dissolved oxygen may limit biodegradation in aqueous environments when dissolved oxygen is less than 1 mg/L. At a dissolved oxygen concentration of 0.5 to 1 mg/L, nitrate may begin to replace oxygen as an oxidant.

Knox et al. (1993) also states that other environmental factors affecting the rate of biodegradation include pH (optimum range is 6.5 to 7.5), temperature (bioactivity increases with increasing temperature), salinity (500 to 35,000 mg/L salt is acceptable), moisture content, nutrient availability, and the presence of inhibitory or toxic compounds (heavy metals, certain acids and bases, high concentrations of certain organic contaminants). The characteristics of contaminants also influence their biodegradability. These characteristics include their sorption capacity and solubility (only dissolved contaminants are assumed to be biodegradable), size (polymers with large structures are not easily metabolized), type of halogen substituent (brominated compounds are more easily degraded than chlorinated compounds), and position of halogen substituent.

At this site, anaerobic conditions are expected to predominate.

7.2 Physical Processes Influencing Contaminant Fate and Transport

The transport of contaminants in the subsurface is affected by a variety of physical characteristics that include:

- Advection
- Hydrodynamic dispersion
- Particle migration
- Specific Density and Viscosity

The processes thought to be important at this site include advective transport and possibly, particle migration.

7.2.1 Advection and Dispersion

Advection is the bulk transport of solute at the same rate as the average linear or seepage velocity of the groundwater, discussed in Section 6.0 and provided in Table 6-6. Estimates of horizontal average linear velocity in the overburden range from 0.2 to 0.6 ft/d and 0.3 to 2.4 ft/d in the bedrock in this study area.

Hydrodynamic dispersion is defined as the motion of solutes relative to the advective transport. It is a scale dependent variation in transport not predicted from Darcian flow theory that has two components, mechanical dispersion and molecular diffusion that are quantified by the dispersion coefficient. Mechanical dispersion is dependent on vertical and horizontal permeability variations, which increase with the degree of heterogeneity and anisotropy and is dependent on whether flow is principally through porous media or nonporous media such as fractured bedrock. Molecular diffusion is the process of solute movement from an area of greater concentration to an area of lower concentration. It can take place with or without associated advective transport (Fetter, 1993).

The dispersion coefficient can be affected by flow velocity and pore configuration. Precise quantification of dispersion coefficients requires site-specific experimental determinations. In hydrogeologic modeling, the coefficient of dispersion (D) is generally shown as:

$$D = \alpha V + D_d$$

where:

D	=	Dispersion coefficient
α	=	Coefficient of mechanical dispersion
α	=	Longitudinal dispersivity (characteristic of the porous medium)
V	=	Average linear velocity
D_d	=	Coefficient of molecular diffusion

The dispersion equation implies that the coefficient of mechanical dispersion is typically much larger than the coefficient of molecular diffusion. This condition is generally accurate except where very low flow velocities are present (Nichols and Sulhotra, 1992).

Although contamination was detected in an upgradient and downgradient bedrock well and downgradient overburden wells, there were insufficient data to determine whether these detections constituted a definable groundwater "plume." Therefore, no estimates of longitudinal or lateral hydrodynamic dispersion were performed for this study.

7.2.2 Particle Transport

Particle transport may be an important method for contaminants adsorbed to soil to be

transported through the overburden to the underlying fractured bedrock aquifer at this site. Particle transport is the movement of small, solid-phase particles (such as inorganic or organic colloids), macromolecules, or emulsions to which contaminants have adhered by sorption, ion exchange, or other means. Hydrophobic organic contaminants with high molecular weights (PAHs, PCBs, and DDT) and heavy metals have a high affinity for mobile subsurface particles, and this attraction alters their mobility (Huling, 1989). Small particles, especially mobile organic carbon phase particles such as biocolloids (bacteria and spores), macromolecules (humic substances, proteins and polymers), and nonaqueous-phase liquids (oil droplets and detergents) are transported in the aqueous phase and may act as mobile sorbents (Huling, 1989).

The transport of mobile organic carbon is influenced by diffusion into the rock or soil matrix, size exclusion due to narrowing of fractures or intergranular apertures, removal by filtration processes, or sorption. For hydrophobic organic contaminants that are strongly sorbed, the presence of mobile organic carbon can increase contaminant mobility significantly, but only at concentrations of 100 mg/L or greater. Such concentrations are usually found only in the vicinity of spill or disposal sites (Huling, 1989), which may have been the case originally at this site. However, such concentrations were only observed during the original Step 1 investigation (Dames and Moore, 1986) and not in any samples obtained after the 1988 removal action.

7.2.3 Specific Density and Viscosity

In the case of pure phase organic compounds, density and viscosity are important transport parameters. Compounds with specific densities less than 1.00 will float on water (light non-aqueous phase liquids [LNAPLs]), whereas those with a specific density greater than 1.00 will sink (dense non-aqueous phase liquids]). The greater the viscosity of a compound, the lower the mobility of that compound through any kind of porous media (Knox et. al., 1993). This aspect of contamination transport is not currently important at this site, because there is no evidence of pure phase product in any media sampled. Pure phase transport may have been important at the time contaminant discharges occurred, because pesticides were stored as liquids in drums which were punctured and allowed to leak to the soil in the PPBA. This issue is addressed in Section 7.5.

7.3 Fate and Transport Properties of Organic Compounds

The fate and transport parameters of organic compounds that exceeded regulatory criteria in various media during the RI are summarized on Table 7-2. The range of concentrations at which these compounds and inorganics were detected for each media, are provided in Table 7-3. Table 7-4 summarizes the calculated K_d and R factors for all organic compounds of concern.

7.3.1 Volatile Organic Compounds

VOCs exceeding regulatory limits in groundwater samples were ethylbenzene (in well bedrock well SW-02) and vinyl chloride (in well downgradient overburden well MW-109). Potential fate and transport processes for VOCs in groundwater include subsurface transport by advection and

TABLE 7-2
FATE AND TRANSPORT PARAMETERS OF
DETECTED ORGANIC COMPOUNDS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

COMPOUND	HENRY'S CONSTANT (atm-m ³ /mol)	LOG K _{ow}	LOG K _{oc}	SOLUBILITY (mg/L)	SPECIFIC Density	VAPOR PRESSURE (mm Hg)
VOCs						
Ethylbenzene	6.60E-03	3.13	2.20	1.52E+02	0.8669	7.08E+00
Vinyl Chloride	1.22E+00	0.60	0.39	1.10E+03	0.9106	2.58E+03
SVOCs						
2,4-Dichlorophenol	6.66E-06	3.13	2.94	4.50E+03	1.4000	8.90E-02
Bis(2-ethylhexyl)phthalate	1.10E-05	4.65	5.00	3.00E-01	0.9873	2.00E-07
Phenol	2.70E-07	1.46	1.43	8.20E+04	1.0576	2.00E-01
Pesticides						
4,4-DDD	2.16E-05	5.99	4.64	2.00E-02	1.4760	1.02E-06
4,4-DDE	2.34E-05	5.77	5.39	4.00E-02	NDA	6.49E-06
4,4-DDT	4.89E-05	6.19	5.38	5.00E-03	1.5600	1.90E-07
Dieldrin	2.00E-05	4.53	4.08	2.00E-01	1.7500	1.80E-07

ABBREVIATIONS:

K_{ow} - Octanol-Water Partition Coefficient
K_{oc} - Organic Carbon Partition Coefficient
atm-m³/mol - atmospheres-meter cubed per mole
mg/L - milligrams per liter
mm Hg - millimeters of mercury
NDA - No Data Available

REFERENCE:

Knox, et.al. 1993. *Subsurface Transport and Fate Processes*.
Boca Raton. Lewis Pubs.

TABLE 7-3
COMPOUNDS AND ANALYTES EXCEEDING REGULATORY
LIMITS OR SITE BACKGROUND LEVELS
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	UNIT	STANDARD	MINIMUM DETECTION	MAXIMUM DETECTION	ANALYTE	UNIT	STANDARD	Nov-95		Mar-96	
								MINIMUM DETECTION	MAXIMUM DETECTION	MINIMUM DETECTION	MAXIMUM DETECTION
Subsurface Soil					Surface Soil						
Organics		12			Inorganics						
2,4-Dichlorophenol	µg/kg	NYSDEC	280	380 U	Chromium	mg/kg	SB	10.2	19.7	NA	NA
4,4'-DDD	µg/kg	NYSDEC	9.9 J	8,900 J	Manganese	mg/kg	SB	481	1,070	NA	NA
4,4'-DDT	µg/kg	NYSDEC	3.6	9,400 J							
Inorganics					Groundwater						
Aluminum	mg/kg	SB	6,200	15,600	Organics	µg/L	NYDWQS	15 J	17 J	10 U	22
Calcium	mg/kg	SB	21,400	35,000	Ethylbenzene	µg/L	NYDWQS	2	7	1	10 U
Chromium	mg/kg	SB	8.7 J	27.5	Vinyl Chloride	µg/L	NYDWQS	7	9	7	10 U
Copper	mg/kg	SB	19.5 J	28.4	2,4-Dichlorophenol	µg/L	NYDWQS	10 U	77	10 U	10 U
Iron	mg/kg	SB	15,300	31,000	Bis(2-ethylhexyl)phthalate	µg/L	NYDWQS	2	7	10 U	10 U
Lead	mg/kg	SB	7.7 J	17.6 J	Phenol	µg/L	NYDWQS	0.013 J	7.1 J	0.009 J	9.7 J
Magnesium	mg/kg	SB	4,270	7,600	4,4'-DDD	µg/L	NYDWQS	0.14 J	0.79 J	0.006 J	0.54 J
Manganese	mg/kg	SB	377 J	667	4,4'-DDE	µg/L	NYDWQS	0.098	8.4 J	0.009 J	11 J
Nickel	mg/kg	SB	14.4	26.7	4,4'-DDT	µg/L	NYDWQS				
Potassium	mg/kg	SB	530	1,520	Inorganics (dissolved)						
Silver	mg/kg	SB	0.52	1.7	Antimony	µg/L	EPA MCL	25.4	28.3	NA	NA
Sodium	mg/kg	SB	14.5	49.8	Iron	µg/L	NYDWQS	28	4,820	37.5	8,470
Zinc	mg/kg	SB	40.8	82.6	Manganese	µg/L	NYDWQS	13.9	3,080	31.2	3,140
					Sodium	µg/L	NYDWQS	12,700	132,000	9,180	113,000
Sediment					Zinc	µg/L	NYDWQS	42.4 J	305 J	13.4 J	169
Organics					Inorganics (total)						
4,4'-DDE	µg/kg	NYSDEC	1.9 J	18	Antimony	µg/L	EPA MCL	23.8	42.7	28.1 U	28.1 U
4,4'-DDT	µg/kg	NYSDEC	1.4 J	36	Cadmium	µg/L	EPA MCL	2.7 U	3.7	4.5	7.6
Dieldrin	µg/kg	NYSDEC	2.5 J	86	Chromium	µg/L	NYDWQS	10.3 U	10.7	10 U	55.4 J
Inorganics					Iron	µg/L	NYDWQS	745	32,600	302	80,100
Aluminum	mg/kg	SB	10,000	14,100	Lead	µg/L	EPA MCL	0.33	2	1.1 U	35
Copper	mg/kg	NYSDEC	14.1	27.7	Manganese	µg/L	NYDWQS	57.5	3,040	71.7	3,250
Iron	mg/kg	NYSDEC	19,500	26,600	Sodium	µg/L	NYDWQS	12,400	133,000	12,700	107,000
Magnesium	mg/kg	SB	3,570	6,070	Zinc	µg/L	NYDWQS	90.6 J	795 J	19.5 J	324
Manganese	mg/kg	NYSDEC	566	1,170							
Potassium	mg/kg	SB	624	1,020							
Thallium	mg/kg	SB	0.17 J	0.6 J							

ABBREVIATIONS:

µg/L - micrograms per liter
mg/kg - milligrams per kilogram
µg/kg - micrograms per kilogram
NA - not applicable
SB - Site Background
EPA MCL - Environmental Protection Agency Maximum Contaminant Level
NYSDEC - New York State Department of Environmental Conservation
NYDWQS - New York Drinking Water Quality Standards

QUALIFIERS:

J - estimated value
U - not detected above detection limit

NOTES:

1. Detection limits used where there was only one detection in a set of data.
2. Both November 1995 and March 1996 groundwater data are provided.

TABLE 7-4
ESTIMATES OF SOIL/WATER DISTRIBUTION COEFFICIENT (Kd)
AND RETARDATION FACTOR (R)
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

COMPOUND	OCTANOL-WATER PARTITION COEFFICIENT (log K _{ow}) ¹	ORGANIC-CARBON PARTITION COEFFICIENT (log K _{oc}) ¹	FRACTION ORGANIC CARBON (f _{oc})	DISTRIBUTION COEFFICIENT (Kd)	BULK DENSITY (g/cc)	LOWER LIMIT EFFECTIVE POROSITY (n _e)	UPPER LIMIT EFFECTIVE POROSITY (n _e)	LOWER LIMIT RETARDATION FACTOR (R)	UPPER LIMIT RETARDATION FACTOR (R)
VOCs									
Ethylbenzene	3.13	2.20	6.90E-03	1.09	2.1	0.01	0.10	231	24
Vinyl Chloride	0.60	0.39	6.90E-03	0.02	2.1	0.01	0.10	5	1
SVOCs									
2,4-Dichlorophenol	3.13	2.94	6.90E-03	6.01	2.1	0.01	0.10	1263	127
Bis(2-ethylhexyl)phthalate	4.65	5.00	6.90E-03	690.00	2.1	0.01	0.10	144901	14491
Phenol	1.46	1.43	6.90E-03	0.19	2.1	0.01	0.10	40	5
Pesticides									
4,4-DDD	5.99	4.64	6.90E-03	301.20	2.1	0.01	0.10	63252	6326
4,4-DDE	5.77	5.39	6.90E-03	1693.75	2.1	0.01	0.10	355688	35570
4,4-DDT	6.19	5.38	6.90E-03	1655.19	2.1	0.01	0.10	347592	34760
Dieldrin	4.53	4.08	6.90E-03	82.96	2.1	0.01	0.10	17422	1743

ABBREVIATIONS

g/cc = grams per cubic centimeter

REFERENCE

Knox, et.al. 1993. Subsurface Transport and Fate Processes. Boca Raton. Lewis Pubs.

dispersion, biodegradation, retardation by sorption, and volatilization into the overlying air spaces.

Ethylbenzene is an aromatic hydrocarbon. Aromatics are important constituents of fuels, cleaning agents, solvents and pesticides. It was detected at trace levels in subsurface soils at Site 2 along with other petroleum-related compounds. The estimates of retardation for this compound range from 24 to 231, which suggest substantial inhibition to migration in the dissolved phase (migration rate of ranging from 0.0009 to 0.11 ft/d), which is supported by the fact that this compound was only detected in source area well SW-02. Ethylbenzene is also relatively volatile (Table 7-2) and would be expected to easily volatilize to the atmosphere from groundwater that discharges to surface water.

Vinyl chloride is a relatively soluble biodegradation breakdown product of chlorinated solvents such as tetrachloroethene, trichloroethene, 1,1-dichloroethene, or cis/trans-1,2-dichloroethene (Vogel, Criddle and McCarthy, 1987). As shown on Table 7-4, it is minimally sorbed to aquifer solids, having very low calculated R factors. According Vogel, Criddle and McCarthy (1987), vinyl chloride would potentially biodegrade to chloroethane or ethylene and carbon dioxide. Vinyl chloride is also highly volatile (Table 7-2) and would be expected to easily volatilize to the atmosphere from groundwater that discharges to surface water. However, neither vinyl chloride or any of its potential parent compounds were detected at Site 2 during this investigation or the previous SI. It was only observed at MW-109, an overburden well downgradient of the landfill, suggesting that vinyl chloride is not associated with the Site 2.

7.3.2 Semi-volatile Organic Compounds

Three semi-volatile organic compounds were detected at levels exceeding regulatory limits: 2,4-dichlorophenol (subsurface soil sample MW-02 and groundwater sample SW-02), BEHP (groundwater sample MW-01) and phenol (groundwater sample SW-02).

Phenol compounds are used in oil and gasoline additives, plasticizers, pesticides, explosives and preservatives. Table 7-2 indicates that they are highly soluble and moderately to highly mobile (relatively low octanol-water partition coefficient [K_{ow}] and K_{oc}), but are not likely to volatilize. Calculated retardation factors for 2,4-dichlorophenol are sufficient to significantly impede dissolved migration in this study area. Phenol is an order of magnitude less sorbable than 2,4-dichlorophenol, but would still be subject to a retardation factor ranging from 40 to 5. Detections of both these compounds were limited to source area well SW-02.

BEHP is often used in plasticizers and is a common laboratory contaminant. It has a relatively low solubility (Table 7-2) and a very strong tendency to adsorb, given its high calculated retardation (Table 7-4). The fact that it is only found in the source area supports the interpretation that it is not expected to migrate significantly through the soil or groundwater.

7.3.3 Pesticides

Chlorinated pesticides found above regulatory levels in this study area include dieldrin and 4,4'-DDT, as well as 4,4'-DDT's breakdown products 4,4'-DDD, and 4,4'-DDE. Dieldrin was only found in sediment samples whereas 4,4'-DDT and its breakdown products were found in subsurface soil, sediment and groundwater at generally low to very low concentrations. Fate and transport parameters evaluated include volatilization, adsorption (and retardation), solubility, biodegradation and hydrolysis.

Henry's Law Constants for these pesticides indicate that they will not volatilize under normal conditions (Table 7-2). The high adsorption coefficients ($\log K_{oc}$ between 4.08 and 5.39) and the low water solubilities (0.2 to 0.005 mg/L) of these compounds make them likely to be retained to the subsurface soils and sediments. In addition, the calculated R factors (ranging from 1,743 to 355,688) shown in Table 7-4, indicate that these compounds are essentially immobile. Another factor inhibiting pesticide migration is the presence of silts and clay in the subsurface soil in the study area that encourage strong adsorption of pesticides.

Although the DDT family of compounds was detected in all 8 wells sampled for the RI, the concentrations of pesticides detected in groundwater were low, with maximum concentrations below or near reference solubility limits for these substances (Table 7-2). For example, the maximum detection of 4,4'-DDT was 8.4J $\mu\text{g/L}$ and its solubility limit is 5 $\mu\text{g/L}$. These compounds were detected at the highest levels at Site 2 in well SW-02. These data are generally consistent with known and calculated fate and transport parameters for these compounds.

The detected pesticides are generally persistent in the environment. According to Fetter (1993), 4,4'-DDT does biodegrade, but its degradation products, 4,4'-DDD (formed under anaerobic conditions) and 4,4'-DDE (formed under aerobic conditions), are at least as toxic as 4,4'-DDT. Further degradation is not likely unless the halogen bonds in the molecules are broken. In addition, 4,4'-DDT, 4,4'-DDE and 4,4'-DDD will not hydrolyze under normal environmental conditions.

7.4 Fate and Transport Properties of Inorganics

Table 7-3 lists the inorganics found above regulatory limits in each media sampled for the RI. Factors that affect transport of inorganics, such as Eh, and pH are summarized in Table 7-5, which presents field parameters recorded during the first groundwater sampling round for both the RI and the LFCIS, with the exception of dissolved oxygen. Field instrumentation used to measure dissolved oxygen during both investigations overestimated dissolved oxygen levels.

Although levels have not been remeasured in all wells as of the date this report was prepared, preliminary data indicate that dissolved oxygen is in the 2 to 3 mg/L range, suggesting that both the overburden and bedrock groundwater flow systems are anaerobic environments. The overburden is slightly basic and the bedrock is slightly acidic. The redox potential of both systems is similar, in the 140 to 160 millivolt range.

TABLE 7-5
GROUNDWATER FIELD PARAMETER SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

NOVEMBER 1995 SAMPLING ROUND						
WELL	BEDROCK			OVERBURDEN		
	TEMPERATURE (C)	Eh (millivolts)	pH	TEMPERATURE (C)	Eh (millivolts)	pH
MW-01	10.6	NI	NI			
MW-04	9.2	104.6	7.43			
MW-05	8.2	170	7.08			
MW-06				8.2	173	6.7
MW-07	9	168.4	6.49			
MW-08				9.4	178.7	6.52
JMW-108						6.26
JMW-109						6.43
MW-09	10.9	146.1	6.60			
MW-10				9.9	126	6.89
MW-11	9.2	179.7	6.59			
MW-12				7.8	164.5	6.69
MW-13						6.87
Mean	9.52	153.76	6.84	8.8	160.55	6.62

TABLE 7-5 (cont.)
GROUNDWATER FIELD PARAMETER SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

March 1996 Sampling Round						
Well	Bedrock			Overburden		
	Temperature (C)	Eh (millivolts)	pH	Temperature (C)	Eh (millivolts)	pH
SW-02	11.1	Not Measured	7.39	5.7	Not Measured	6.82
SW-03	11.1		7.68			7.18
JMW-108	7.6	Not Measured	7.01	4.9	Not Measured	7.44
JMW-109				5.1		6.70
MW-09				8.8		7.04
MW-10	9.93	Not Measured	7.36	6.1	Not Measured	7.04
MW-13						
Mean						

ABBREVIATIONS:

NI - Measurements Not Included

As shown in Table 7-3, the inorganic constituents detected in both dissolved and total metals groundwater samples had similar concentrations (same order of magnitude), with the exception of iron in both rounds and chromium and cadmium in the second round. The data suggest that chromium, cadmium, and iron are primarily found sorbed to particles in the aquifer, whereas antimony, manganese, sodium and zinc are most likely in the dissolved phase. Most inorganics detected in subsurface soils (including chromium, copper, lead, magnesium, nickel, potassium and silver) are likely to remain in the sorbed phase unless pH or redox conditions change in the subsurface and aquifer.

7.5 Transport Pathways

This section discusses potential contamination transport pathways and possible receptors in the study area.

7.5.1 Model of Contaminant Discharge

DDT is the primary contaminant of concern at Site 2. It was reportedly discharged to the ground in liquid form. According to Smith (1996), liquid preparations of DDT were commonly available in either a 25 percent emulsifiable liquid in water (that is, a suspension) or up to a 50 percent concentration dissolved in kerosene, fuel oil, vegetable oil (soy bean, sesame seed, tung, cotton seed), xylene, acetone or cyclohexane. Smith (1996) indicated that the solvents of choice were usually acetone, kerosene or fuel oil, because they were inexpensive and had a long shelf life.

If DDT was discharged as an aqueous emulsion, the liquid would have either quickly evaporated or been absorbed into the soil, leaving behind the solid form of DDT in the soils. If DDT were dissolved in acetone, the acetone would likely quickly evaporate (its Henry's Law Constant is 3.97×10^{-5} atm-m³/mol), preferentially leaving behind the DDT. If DDT were dissolved in fuel oil or kerosene, the solution would most likely have migrated to the water table as a free product, where the carrier solvent would have been subject to relatively rapid biodegradation and dissolution typical of petroleum products, leaving behind a heavy residue to which the chlorinated DDT would readily adsorb. In addition, DDT would readily adsorb to the fine-grained soil particles.

Regardless of the form of the original product, the DDT and its liquid carrier would not have migrated any substantial distance from the pesticide pit in its pure form, due to the density and fine-grained nature of the lodgement till soils. Because there is no evidence of any residual LNAPL in the overburden or the bedrock in the vicinity of the PPBA, it is likely that any carrier solvent has volatilized, biodegraded or dissolved to nearly undetectable levels. The presence in some samples groundwater from nearby well SW-02 of trace levels of the VOC ethylbenzene and phenolic SVOCs that are associated with petroleum products such as kerosene or fuel oil supports this concept.

7.5.2 Model of Contamination Surface Migration Pathway

Contamination present in surface soils (mainly low levels of pesticides and metals) is expected to remain strongly sorbed to organic matter and fine-grained material. The primary mode of transport will be via rainfall generated runoff that will carry particulate matter downslope to the wetlands and Murphy's Gulch, where particulate matter will settle into sediment. Contaminated sediments may be resuspended and carried further downstream during high flow events, such as spring snowmelt or major storms. A secondary surface migration pathway would be leaching of contaminants from surface soils during rainwater infiltration into the weathered till. These migration pathways are illustrated in Figure 7-1, a schematic model of contamination transport.

7.5.3 Model of Contamination Subsurface Migration Pathway

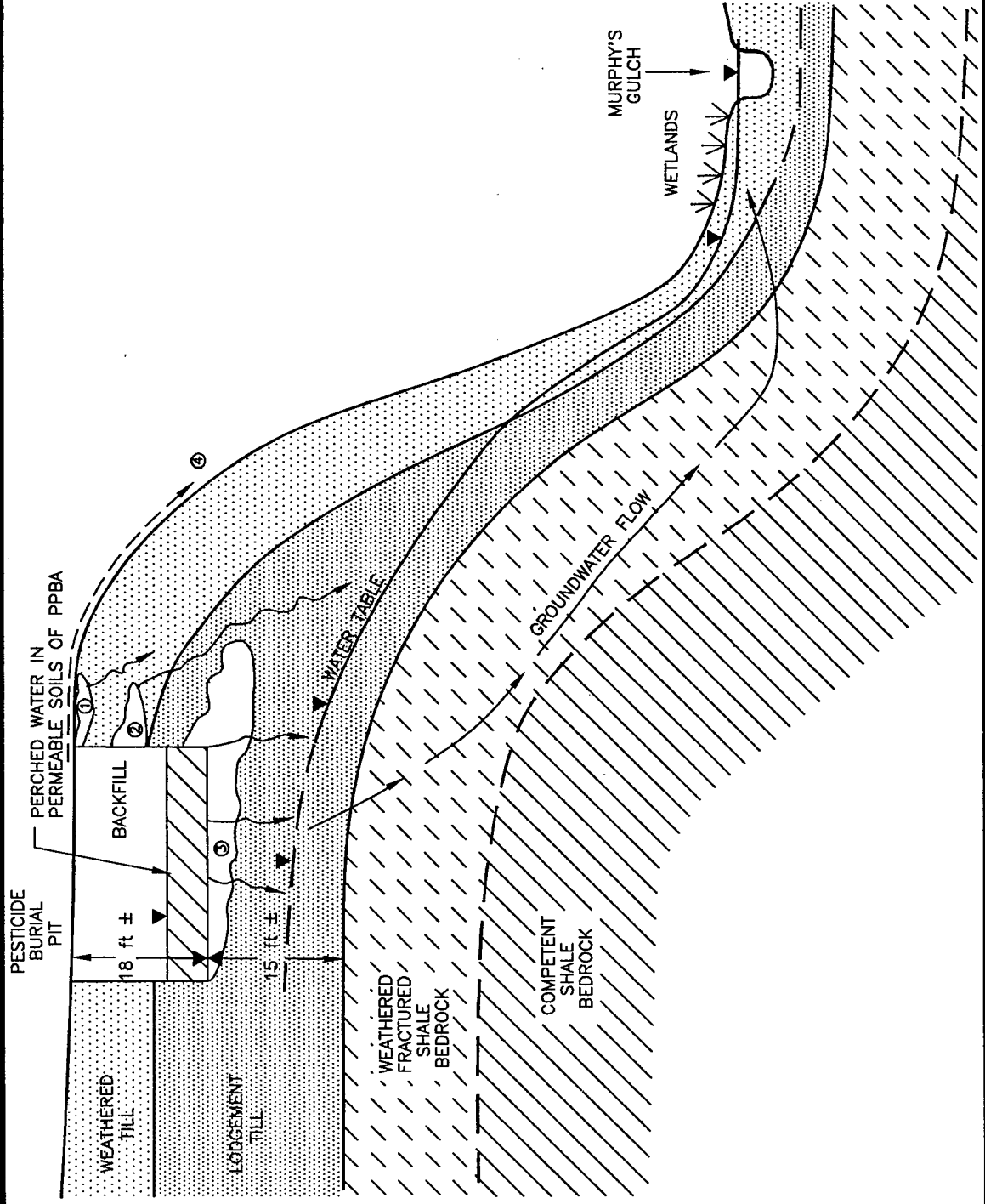
Contamination present in subsurface soils (mainly low levels SVOCs and moderate levels of pesticides and metals) are also expected to remain strongly sorbed to organic matter and fine-grained material in the glacial till soil. Leaching of metals is expected to occur as acidic rains leach through the soils.

Two subsurface pathways are postulated for sorbed contamination, both of which are shown on Figure 7-1:

1. For the residual contamination that spread laterally from the PPBA either in weathered till or lodgement till, dissolved phase contamination or contamination sorbed to particulate matter would migrate via infiltrating stormwater runoff, which would carry contamination through secondary desiccation cracks, fissures, and fractures in the till to the deeper overburden and underlying bedrock aquifer.
2. Residual contamination directly beneath the PPBA may have leached to groundwater. As infiltrated runoff that accumulated in the PPBA built up over time, the water in the pit rose to a level where it would have eventually overcome capillary forces and migrated downward through the base of the pit, carrying either sorbed or dissolved phase contamination through secondary desiccation cracks, fissures, and fractures in the till to the deeper overburden and underlying bedrock aquifer. Vertical seepage velocity through this latter pathway would be approximately 0.012 ft/d or approximately 4.5 feet per year, allowing particulate or dissolved contamination to migrate by advective transport to the water table within two to four years, depending on the seasonal depth to groundwater¹.

¹Assuming the following:

- A vertical hydraulic conductivity of 3.5×10^{-3} ft/d (two orders of magnitude less than the average overburden horizontal hydraulic conductivity calculated from slug test data).
- Estimated overburden effective porosity of 10 percent (highest estimated effective porosity).
- A vertical hydraulic gradient of 0.35 (comparing head data in MW-3 to SW-2, see Table 6-4).



- LEGEND**
- PESTICIDES ADSORBED IN SOIL
 - LEACHING TO GROUNDWATER
 - GROUNDWATER FLOW
 - SURFACE WATER FLOW
- NOTES**
- ① SURFACE RUNOFF AND INFILTRATION INTO TOPSOIL
 - ② FLOW OF INFILTRATION WATER FROM PPBA TO CONTAMINATION IN WEATHERED TILL AND LEACHING TO GROUNDWATER
 - ③ INFILTRATION OF PERCHED WATER IN PPBA THROUGH RESIDUAL ADSORBED CONTAMINATION IN LODGEEMENT TILL AND LEACHING OF CONTAMINATION TO GROUNDWATER
 - ④ RUNOFF CONTAINING CONTAMINATED SOIL PARTICLES FLOWING OVERLAND TO WETLANDS AND SURFACE WATER

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STEWART AIR NATIONAL GUARD BASE
CONCEPTUAL MODEL OF CONTAMINANT MIGRATION

NEWBURGH, NEW YORK

FIGURE: 7-1

In either case, dissolved phase contamination and contamination sorbed to particulate matter would flow downgradient with groundwater flow, towards Murphy's Gulch, where vertical gradients become upward. Groundwater would discharge to the weathered till overburden and eventually, to the wetlands and the stream in Murphy's Gulch.

7.6 Summary

1. For organic compounds, adsorption to organic material and fines in the overburden appear to play a major role in the inhibition of substantial contaminant migration from the source area. The primary organic contaminants of interest, the pesticides 4,4'-DDT, 4,4'-DDE and 4,4'-DDD, have very low solubilities, very high sorption potential and high retardation factors. They are migrating through the bedrock aquifer with no substantial biodegradation or volatilization at concentrations at or below their solubility limits. Detected VOCs and SVOCs are also strongly inhibited by adsorption processes and are not expected to migrate any substantial distance from the source area. Although vinyl chloride, a biodegradation breakdown product of chlorinated solvents, was detected, it was found only downgradient of the landfill. None of its parent compounds were detected in the source area, thus vinyl chloride is not thought to be associated with the Site 2.
2. Metals are primarily affected by adsorption processes. With the exception of iron, the metals detected in groundwater are those that would be expected to be found in solution under the known conditions of dissolved oxygen, pH and Eh. Most metals found in soils and sediment are expected to remain sorbed unless substantial changes in aquifer pH or redox conditions occur.
3. Flow path analysis indicates that whether contaminants migrate via surface runoff or through groundwater, the ultimate transport destination appears to be the wetlands and surface water of Murphy's Gulch, located topographically and hydrologically downgradient of Site 2.
4. DDT, the primary pesticide contaminant of interest, was usually prepared in two liquid forms, an emulsion in water or as a solute in acetone, kerosene or fuel oil. Given this information, the pesticide and its liquid carrier would not have migrated any substantial distance from the pesticide pit in its pure form, due to the density and fine-grained nature of the lodgement till soils. Because there is no evidence of any residual LNAPL in the overburden or the bedrock in the vicinity of the Site 2, it is likely that any carrier solvent has volatilized, biodegraded or dissolved to nearly undetectable levels. The presence in some samples groundwater from nearby well SW-02 of trace levels of the VOC ethylbenzene and phenolic SVOCs that are associated with petroleum products such as kerosene or fuel oil supports this idea.

SECTION 8.0

8.0 RISK ASSESSMENT

This section presents the risk assessment for Site 2 at Stewart ANG Base. The risk assessment is divided into two major parts; the Baseline Risk Assessment (BRA), or human health risk evaluation, and the ecological risk evaluation. The BRA was conducted in accordance with Volume I of the EPA document, "Risk Assessment Guidance for Superfund Manual" (RAGS), while the ecological risk evaluation was conducted in accordance with Volume II of RAGS, along with other more recent supplemental guidance documents. A complete list of the references used in performing the risk assessment is provided in Section 11.0.

8.1 Human Health Risk Assessment

8.1.1 Introduction

The primary objective of the human health risk assessment is to quantify the risks posed by the chemicals detected at Site 2 to the various site receptors. The risk assessment is a component of the RI process, and therefore, the data collection activities and data quality objectives (DQOs) of the RI were developed in part for the risk assessment. All data used in this risk assessment were obtained during the 1995 and 1996 RI field sampling programs. Soil, sediment and groundwater samples were collected during the 1995 field program, with a second round of groundwater samples collected in March 1996. Data from the previous SI were not used because the DQOs of the risk assessment were not met by this older data.

The DQOs, as specified in the project-specific QA/QC plan (Appendix B of the RI/FS Work Plan) called for all samples to be analyzed in a NYSDEC-approved laboratory in accordance with New York State CLP protocols. Next, ten percent of these samples were to be validated according to the EPA Region II *CLP Organics Data Review and Preliminary Review, SOP Number HW-6* (EPA, 1992a) and EPA Region II *Evaluation of Metals Data for the Contract Laboratory Program, SOP Number HW-2* (EPA, 1992b). The goals for accuracy, precision, and completeness spelled out in the project-specific QA/QC plan were also part of the DQOs.

An important facet of the risk assessment is developing a clear understanding of the site surroundings with regards to land use, population, ecological habitats, and plans for development, as these issues are critical to determining the receptors to be evaluated in the risk assessment. A number of different sources were used to determine the demographics of the current Base area, as well as develop hypotheses regarding future land use on and around the Base. These sources include:

- Base Civil and Environmental Personnel
- Census Bureau

- Town of Newburgh
- Town of New Windsor
- Orange County.

8.1.1.1 Risk Assessment Process

The EPA BRA process is separated into five distinct steps: Data Evaluation, Exposure Assessment, Toxicity Assessment, Risk Characterization, and Uncertainty Assessment. Each step is described below.

Data Evaluation - The data evaluation step describes the nature and degree of contamination at Site 2, and also identifies the chemicals of potential concern (COPCs). Included in the data evaluation process is an assessment of site background conditions. The end result of the data evaluation process is a list by media of the COPCs and their respective concentrations to be considered in the risk assessment.

Exposure Assessment - The exposure assessment step is used to estimate the type and magnitude of exposures to the COPCs at the site identified in the data evaluation step. These COPCs may be present on-site, migrating off site, or both. The exposure assessment includes 3 steps: characterization of the exposure setting, identification of the exposure pathways, and quantification of exposure.

Toxicity Assessment - The toxicity assessment step presents the toxicity values used to evaluate the site exposures with respect to potential adverse health effects. The toxicity values were obtained from multiple EPA sources.

Risk Characterization - The risk characterization step integrates the results of the exposure assessment and toxicity assessment steps in order to provide quantitative and qualitative expressions of risk. Risk evaluations are conducted for both carcinogenic and noncarcinogenic effects.

Uncertainty Assessment - Assumptions and uncertainties are present in each of the four steps described above, with varying impacts on the overall assessment of risk for the site. These uncertainties are addressed in this section.

8.1.1.2 Organization of Human Health Risk Assessment

The human health risk assessment is divided into six major sections. Section 8.1.1 provides an introduction. Section 8.1.2 provides the data evaluation and includes discussions of exposure point concentrations, summarizes the sampling and data validation steps, and includes the calculation of the exposure point concentrations and the selection of the COPCs. Section 8.1.3 includes a characterization of the exposure setting, an identification of the exposure pathways, and provides the exposure quantifications. Section 8.1.4 is the toxicity assessment, and includes discussions of health criteria for noncarcinogenic and carcinogenic effects. Section 8.1.5 is the

risk characterization, and includes the calculations of the noncarcinogenic and carcinogenic risks, as well as an estimate of the risks from lead exposure at Site 2. Section 8.1.6 provides a discussion of the uncertainties inherent to the BRA, and describes the potential impact of these uncertainties on the final risk estimates.

8.1.2 Data Evaluation

8.1.2.1 Introduction

The objective of this portion of the risk assessment is to determine the COPCs at the site and their respective exposure point concentrations to be used in the quantitative risk assessment. Exposure point concentrations were determined for each exposure pathway and later used to calculate the risk associated with that exposure pathway. This section includes a discussion of the sampling programs used to provide the data for the risk assessment, evaluation of the data with regards to data validation and suitability for risk assessment, an analysis of background conditions, the derivation of the exposure point concentrations, a discussion of data validation results, and selection of COPCs for the risk assessment.

8.1.2.2 Summary of Sampling Program

All RI site data were evaluated to determine representative concentrations of each COPC. This evaluation includes tasks such as addressing non-detected analytes, evaluation of background conditions, and performing statistical analyses of the data sets.

The media sampled for this RI were soil, groundwater, and sediment. Table 8-1 provides a summary of the samples collected during the RI field program which were used in the risk assessment.

Soils - Three different soils data sets were developed. Sediment data were grouped with the soils data for the risk assessment. The sediment samples collected were from drainage areas which are dry much of the year so that the type of exposures to the sediment would be the same as to the surface soils. The complete set of soils data was used to evaluate exposures to future construction workers, as the nature of construction work indicates a potential for exposure to surface and subsurface soils. Soils from all depths sampled were included. Duplicate samples were considered distinct data points, with no averaging of duplicate pairs conducted. The surface soil/sediment data sets were assembled from all soils collected at depths of 0 to 2 feet bgs. Two data sets were developed. One used all the surface soil/sediment data which was used for evaluating exposures to future site residents and site workers. A subset of these data, the sediment samples, was used to evaluate exposures to area residents, as these data were reflective of conditions outside the fenced Base area, and would be accessible to area residents.

Groundwater - The groundwater data were obtained from two sampling rounds, one conducted in November 1995, and the second conducted in March 1996. All samples were obtained from monitoring wells. The nearest private well is located just over 2,000 feet from Site 2.

TABLE 8 - 1
SITE 2 SAMPLING PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MEDIA	SAMPLE ID ¹	VOCs	SVOCs	PEST/PCBS	INORGANICS	TOC	NOTES
Soil	MW-01-04	X	X	X	X	X	Background
Soil	MW-01-18	X	X	X	X	X	Background
Soil	MW-01-31.6	X	X	X	X	X	Background
Soil	SB-01-02	X	X	X	X	X	Background
Soil	SB-01-18.5	X	X	X	X	X	Background
Soil	SB-01-32.5	X	X	X	X	X	Background
Soil	SB-02-02	X	X	X	X	X	
Soil	SB-02-06	X	X	X	X	X	
Soil	SB-02-10.2	X	X	X	X	X	
Soil	SB-03-1.3	X	X	X	X	X	
Soil	SB-03-06	X	X	X	X	X	
Soil	SB-03-56	X	X	X	X	X	
Soil	SB-03-22	X	X	X	X	X	
Soil	SB-04-02	X	X	X	X	X	
Soil	SB-04-06	X	X	X	X	X	
Soil	SB-04-21	X	X	X	X	X	
Soil	SB-05-02	X	X	X	X	X	
Soil	SB-05-06	X	X	X	X	X	
Soil	SB-05-22	X	X	X	X	X	
Soil	SB-06-02	X	X	X	X	X	
Soil	SB-06-26.5	X	X	X	X	X	
Soil	SB-06-34.5	X	X	X	X	X	
Soil	SB-07-02	X	X	X	X	X	
Soil	SB-07-16	X	X	X	X	X	
Soil	SB-07-33	X	X	X	X	X	
Soil	SB-17-33	X	X	X	X	X	Dup. of SB-07-33
Soil	MW-02-17	X	X	X	X	X	
Soil	MW-02-31	X	X	X	X	X	
Soil	MW-03-22	X	X	X	X	X	
Soil	MW-03-32	X	X	X	X	X	
Soil	SS-01	X	X	X	X	X	Background
Soil	SS-02	X	X	X	X	X	
Soil	SS-03	X	X	X	X	X	Background
Soil	SS-04	X	X	X	X	X	
Soil	SS-05	X	X	X	X	X	
Soil	SS-06	X	X	X	X	X	
Soil	SS-07	X	X	X	X	X	
Soil	SS-15	X	X	X	X	X	Dup. of SS-05

TABLE 8 - 1 (cont.)
SITE 2 SAMPLING PROGRAM SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

MEDIA	SAMPLE ID ¹	VOCs	SVOCs	PEST/PCBS	INORGANICS	TOC	NOTES
Groundwater	MW-01-1128	X	X	X	X		Dup. of SW-02-1128
Groundwater	SW-02-1128	X	X	X	X		
Groundwater	SW-12-1128	X	X	X	X		
Groundwater	SW-03-1128	X	X	X	X		
Groundwater	MW-09-1127	X	X	X	X		
Groundwater	MW-10-1128	X	X	X	X		
Groundwater	JMW-108-1128	X	X	X	X		
Groundwater	JMW-109-1128	X	X	X	X		
Groundwater	MW-13-1128	X	X	X	X		
Groundwater	MW-10-1128	X	X	X	X		
Groundwater	MW-01-0320	X	X	X	X		Dup. of SW-02-0320
Groundwater	SW-02-0320	X	X	X	X		
Groundwater	SW-12-0320	X	X	X	X		
Groundwater	SW-03-0321	X	X	X	X		
Groundwater	MW-09-0321	X	X	X	X		
Groundwater	MW-10-0321	X	X	X	X		
Groundwater	JMW-108-0321	X	X	X	X		
Groundwater	JMW-109-0321	X	X	X	X		
Groundwater	MW-13-0320	X	X	X	X		

ABBREVIATIONS

TOC - Total Organic Carbon

VOCs - Volatile Organic Compounds by method NYSDEC CLP

SVOCs - Semivolatile Organic Compounds by method NYSDEC CLP

Pest/PCBs - Pesticides/Polychlorinated Biphenyls by method NYSDEC CLP

NOTES

1. Last four digits of groundwater sample ID indicates date sampled for November 1995 and March 1996.

All monitoring wells were installed such that the screened interval for the well was within the weathered shale layer, which is the primary aquifer of concern. Seasonally, there is water in the overburden, but this unit is not believed to be a distinct aquifer. Four of the monitoring wells are located within the fenced area of the Base and four are located outside the fenced area, though still within the Base boundaries. For the purposes of the risk assessment, each sample was considered an individual sample, no averaging was conducted. Duplicate samples were also considered distinct data points.

Both unfiltered (total) and filtered (dissolved) samples were collected for the metals analysis of the groundwater samples. The unfiltered data were used in the risk assessment, as described in RAGS. The difference in concentrations of the metals from the total to dissolved results does add a measure of uncertainty to the risk assessment. This uncertainty is discussed in Section 8.1.6.

8.1.2.3 Data Validation and Reduction

All data used in this risk assessment underwent a formal data validation process conducted in accordance with the most current EPA functional guidelines. The data validation reports are in Appendix L. As part of the data validation process, the data validator compiled the data in a format useable in the risk assessment. All data were presented with one or more of three qualifiers, "U" for non-detect, "J" for estimated, or "R" for rejected, while some data remained without qualifiers. For analyses with reextractions or dilutions, the data recommended for use by the validator was included, so that only one data point was included for each sample. The same was true for diluted samples. Field duplicates were reported as separate samples.

8.1.2.4 Evaluation of Background Concentrations

The next step in the risk assessment was to evaluate the background concentrations and compare these concentrations to the sample concentrations. This evaluation is conducted for inorganics only, as all organic COPCs are assumed to be contributed from historical site activities. One background boring (SB-01) and one background well (MW-01) were installed, and three soil samples were collected from each. In addition, two sediment samples SS-01 and SS-03 were collected. For the purposes of the risk assessment, all eight soil samples were grouped as the background soil data set. After calculating the groundwater contours at the site and evaluating the groundwater data, it was determined that MW-01 was probably located hydraulically down- or cross-gradient from Site 2, and could not be used for background groundwater data. A complete discussion of this issue is provided in Section 6.0.

The background data were evaluated in the same manner as the sample data. The mean and standard deviation were calculated for each metal. The coefficient of variation was calculated, and the data evaluated to determine if it followed a normal distribution. All the metals displayed normal distributions, so it was not necessary to log transform any of the data.

The background data was then compared to the sample data using the Student's t-Test. A data

set consisting of all site soils and sediments was used. The method followed EPA guidance for groundwater (EPA, 1983), and involved calculating a t-statistic from the two data sets, and comparing this value to a tabulated t-statistic obtained for the 95th confidence interval. The following equation was used to calculate the t-statistic:

$$t^* = \frac{\bar{x}_{(m)} - \bar{x}_{(b)}}{\sqrt{\frac{s_{(m)}^2}{n_{(m)}} + \frac{s_{(b)}^2}{n_{(b)}}}}$$

where:

t^*	=	calculated t-statistic
$\bar{x}_{(m)}$	=	mean of the population
$\bar{x}_{(b)}$	=	background mean
$s_{(m)}$	=	standard deviation of the population
$n_{(m)}$	=	number of samples in the population
$s_{(b)}$	=	background standard deviation
$n_{(b)}$	=	number of samples in the background.

The results of the analysis are included in Table 8-2. If the calculated t-statistic was less than the tabulated t-statistic, it meant that the mean of the sample data set was not significantly greater than the mean of the background data set, and the metal was eliminated from consideration in the risk assessment for soils. As shown in Table 8-2, this was the case for all of the metals detected in soils. In fact, the negative value of the calculated t-statistic indicates the background mean was often greater than the sample mean. Eliminating metals from the risk evaluation is not unreasonable, as Site 2 is a former pesticide disposal area, and metals are not a historical contaminant of concern. However, because it was not possible to perform the statistical comparison, and in order to be conservative, all metals detected in groundwater were retained in the Site 2 BRA. Furthermore, lead was retained in soils because the EPA Biokinetic Uptake Model looks at the lead concentrations from all media, even if background is not exceeded in that media. This does not mean that risks from lead in soils were explicitly calculated, but rather that lead in soils is a component of overall lead risks.

Even though metals are looked at in the BRA, it should be noted that it is likely that metals detected in groundwater are reflective of background conditions rather than contamination from Site 2 because no elevated metals concentrations were evident in soils at Site 2.

8.1.2.5 Calculation of Exposure Point Concentrations

The analytical data were then evaluated statistically in order to calculate exposure point concentrations. The mean and standard deviation of each chemical were calculated. For non-detect results, a value of one-half of the detection limit for that analysis was used as the

TABLE 8 - 2
STATISTICAL COMPARISON OF METALS IN SITE 2 SOILS TO BACKGROUND
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

	BACKGROUND			POPULATION (EXCLUDING BACKGROUND)			t STATISTIC (COMPARISON)	t STATISTIC (CALCULATED)	ELIMINATED FROM RISK ASSESSMENT
	N	X AVERAGE (mg/kg)	S STD. DEV.	N	X AVERAGE (mg/kg)	S STD. DEV.			
INORGANICS	COUNT			COUNT					
Aluminum	8	10779	978	33	10022.1	2110.7	1.70	-1.50	yes
Antimony	8	5.2	4	33	4.1	1.9	1.70	-0.78	yes
Arsenic	8	4.4	1	33	3.9	1.3	1.70	-1.37	yes
Barium	8	45.1	8	33	42.6	14.9	1.70	-0.65	yes
Beryllium	8	0.71	0.17	33	0.5	0.2	1.70	-3.12	yes
Calcium	3	22767	850	8	25687.5	4931.9	1.90	1.61	yes
Chromium	8	15.7	1	33	14.4	3.5	1.70	-1.80	yes
Cobalt	8	10.2	1	33	9.4	1.9	1.70	-1.43	yes
Copper	8	23.4	3	33	21.9	4.3	1.70	-1.15	yes
Iron	8	22788	1271	33	21000.0	3115.9	1.70	-2.54	yes
Lead	8	12.6	2	23	13.5	3.5	1.70	0.76	yes ¹
Magnesium	8	6323	796	33	5427.0	1027.0	1.70	-2.69	yes
Manganese	8	580	51	33	651.9	224.9	1.70	1.66	yes
Mercury	8	0.02	0.00	33	0.02	0.005	1.70	1.00	yes
Nickel	8	22.6	2	33	20.1	4.0	1.70	-2.66	yes
Potassium	8	956	221	33	859.7	226.5	1.70	-1.10	yes
Silver	8	0.66	0.37	33	0.7	0.3	1.70	0.06	yes
Sodium	3	36.8	16	4	33.8	15.1	2.35	-0.25	yes
Thallium	8	0.48	0.33	33	0.2	0.2	1.70	-2.11	yes
Vanadium	8	13.4	2	33	12.8	2.8	1.70	-0.66	yes
Zinc	8	60.5	4	33	57.8	11.8	1.70	-1.06	yes

ABBREVIATIONS

mg/kg - milligrams per kilogram

NOTES

- While lead is not explicitly included in the risk assessment, the concentration of lead in soil was used as an input to EPA's biokinetic uptake model which was used to evaluate effects from lead exposure at Site 2.

concentration. For example, if a chemical was reported as "10 U $\mu\text{g/kg}$," a value of 5 $\mu\text{g/kg}$ was used in calculating the exposure point concentration. For each chemical, the mean and standard deviation were calculated. Next, the coefficient of variation was calculated by dividing the standard deviation by the mean. The purpose of calculating the coefficient of variation was to determine if the chemical concentrations were normally distributed. If the coefficient of variation was less than 1.0, the distribution was assumed to be normal. If the coefficient of variation was greater than 1.0, the distribution was assumed to be lognormal. Lognormal distributions of data are common in environmental investigations because a chemical is frequently found in high concentrations in 1 or 2 samples, and not detected in the remainder of the samples.

For the COPCs with normal distributions, the 95th percent upper confidence limit (UCL) of the mean was calculated using the following formula:

$$95th\ UCL = \bar{x} + t \frac{s}{\sqrt{n-1}}$$

where:

95th UCL = the 95th percent UCL of the mean
 \bar{x} = the mean concentration
 s = the standard deviation of the sample results
 t = the t-statistic for a one-tailed t-test at the 95th confidence interval
 n = the number of samples.

For the COPCs with lognormal distributions, the 95th UCL of the mean was calculated using the following formula (Gilbert, 1987):

$$95th\ UCL = e^{(\bar{x} + 0.5s^2 + \frac{Hs}{\sqrt{n-1}})}$$

where:

\bar{x} = the mean concentration of the log transformed data
 95th UCL = the 95th percent UCL of the mean
 s = the standard deviation of the log transformed data
 H = the H-statistic at the 95th confidence interval
 n = the number of samples.

The 95th UCL of the mean for each chemical was then compared to the maximum detected concentration, with the lower of the two values used as the exposure point concentration.

8.1.2.6 Selection of COPCs

The final list of COPCs and the exposure point concentrations are provided in Tables 8-3 through 8-7. All detected contaminants with the exception of metals in soils were retained in the risk assessment, in order to provide a conservative estimate of the site risks.

Table 8-3 contains the complete set of soil data. These data are used for evaluating exposures to both surface and subsurface soils as a combined pathway. Table 8-4 contains the surface soil/sediment data, which are used to evaluate exposures to surface soils only. Table 8-5 contains the sediment data only. These data best reflect the surface soil conditions outside the fenced Base boundary, and are used to evaluate surface soil exposures to area residents. Table 8-6 contains the groundwater data. Table 8-7 lists all COPCs, and lists for which media the COPC was retained.

8.1.3 Exposure Assessment

The objective of the exposure assessment is to estimate the exposure to site-related contamination. The exposure assessment consists of three steps:

Characterize the exposure setting - This is a qualitative step in which the general characteristics of the site and the local populations are evaluated. Much of this information is included in Sections 1.0 through 3.0 of this RI report, and summarized below.

Identify the exposure pathways - This step identifies the ways the different receptors may be exposed to the contaminants originating from the source (pesticide pit). Each exposure pathway includes an exposure point (i.e., area of contaminated soil), and an exposure route (i.e., ingestion).

Quantify the exposure - This step quantifies the frequency and duration of exposure for target populations.

8.1.3.1 Characterization of Exposure Setting

Site 2, as described in Section 2.0, is part of the Stewart ANG Base located at Stewart International Airport. Site 2 is a former trench, now filled in, which was used in the late 1960's as a pesticide disposal area. Complete discussions of the environmental setting of Site 2, including geology, hydrology, hydrogeology, and soils are in Section 2.0. Key features of the environmental setting pertinent to the BRA are described below.

In the vicinity of Site 2, bedrock occurs at depths between 45 and 50 feet, while downslope from Site 2, the shale occurs at depths between 15 and 25 feet. A zone of weathered shale ranging from 2.5 to 22 feet in thickness is found at the bedrock/overburden contact. In the vicinity of Site 2, groundwater was encountered in the shale at a depth of approximately 35 to 50 feet below grade. Downslope from Site 2, groundwater and the shale were encountered at depths

TABLE 8 - 3
SITE 2 SOIL RISK ASSESSMENT DATA SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	NUMBER OF SAMPLES	AVERAGE CONC.	STANDARD DEVIATION	COEFF. OF VARIATION	NORMAL/ LOGNORMAL	MAXIMUM CONC.	95TH UPPER CONF. LIMIT	EXPOSURE POINT CONC.
VOCs (µg/kg)								
2-Butanone	33	6	1	0.19	Normal	3	6	3
Benzene	33	5	2	0.34	Normal	7	6	6
Carbon Disulfide	33	5	2	0.46	Normal	3	5	3
Chlorobenzene	33	6	1	0.19	Normal	3	6	3
Chloroform	33	6	1	0.21	Normal	2	6	2
Ethylbenzene	33	6	2	0.34	Normal	17	6	6
Methylene Chloride	33	5	4	0.76	Normal	25	7	7
Toluene	33	5	2	0.39	Normal	3	6	3
Total Xylenes	33	4	2	0.50	Normal	5	5	5
SVOCs (µg/kg)								
2,4-Dichlorophenol	33	189	18	0.09	Normal	280	195	195
2-Methylaphthalene	33	353	721	2.04	Lognormal	3800	361	361
Bis(2-ethylhexyl)phthalate	33	179	31	0.17	Normal	72	188	72
Benzo(a)anthracene	33	185	7	0.04	Normal	170	187	170
Benzo(a)pyrene	33	187	8	0.05	Normal	220	189	189
Benzo(b)fluoranthene	33	190	22	0.12	Normal	310	196	196
Benzo(k)fluoranthene	33	185	8	0.04	Normal	160	187	160
Benzo(g,h,i)perylene	33	187	7	0.04	Normal	210	189	189
Carbazole	33	183	17	0.10	Normal	92	188	92
Chrysene	33	188	14	0.08	Normal	260	192	192
Dibenz(a,h)anthracene	33	182	23	0.13	Normal	56	189	56
Di-n-butylphthalate	33	177	34	0.19	Normal	54	188	54
Indeno(1,2,3-cd)pyrene	33	186	6	0.03	Normal	180	187	180
Fluoranthene	33	177	72	0.40	Normal	480	199	199
Naphthalene	33	359	747	2.08	Lognormal	4300	369	369
Phenanthrene	33	183	20	0.11	Normal	210	189	189
Pyrene	32	178	56	0.31	Normal	370	195	195
PEST/PCBs (µg/kg)								
4,4'-DDD	31	330	1598	4.84	Lognormal	8900	315	315
4,4'-DDE	31	16	39	2.49	Lognormal	190	30	30
4,4'-DDT	31	479	1828	3.82	Lognormal	9400	1272	1272
alpha-Chlordane	32	2	3	1.80	Lognormal	16	2	2
gamma-Chlordane	32	3	11	3.79	Lognormal	63	2	2
Dieldrin	30	9	22	2.55	Lognormal	86	12	12

ABBREVIATIONS

µg/kg - micrograms per kilogram

TABLE 8 - 4
SITE 2 SURFACE SOIL/SEDIMENT RISK ASSESSMENT DATA SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	NUMBER OF SAMPLES	AVERAGE CONC.	STANDARD DEVIATION	COEFF. OF VARIATION	NORMAL/ LOGNORMAL	MAXIMUM CONC.	95TH UPPER CONF. LIMIT	EXPOSURE POINT CONC.
VOCs ($\mu\text{g}/\text{kg}$)								
Methylene Chloride	15	5	1	0.23	Normal	1	6	1
Toluene	15	5	1	0.26	Normal	3	6	3
Total Xylenes	15	4	2	0.50	Normal	5	5	5
SVOCs ($\mu\text{g}/\text{kg}$)								
Benzo(a)anthracene	15	186	9	0.05	Normal	170	190	170
Benzo(a)pyrene	15	189	11	0.06	Normal	220	195	195
Benzo(b)fluoranthene	15	195	33	0.17	Normal	310	211	211
Benzo(k)fluoranthene	15	185	10	0.06	Normal	160	190	160
Benzo(g,h,i)perylene	15	189	10	0.05	Normal	210	193	193
Carbazole	15	181	26	0.14	Normal	92	193	92
Chrysene	15	192	20	0.11	Normal	260	202	202
Dibenz(a,h)anthracene	15	178	35	0.19	Normal	56	195	56
Di-n-butylphthalate	15	160	58	0.36	Normal	54	187	54
Indeno(1,2,3-cd)pyrene	15	187	8	0.04	Normal	180	190	180
Fluoranthene	15	178	102	0.57	Normal	480	226	226
Phenanthrene	15	189	10	0.05	Normal	210	193	193
Pyrene	15	180	74	0.41	Normal	370	214	214
PEST/PCBs ($\mu\text{g}/\text{kg}$)								
4,4'-DDD	13	14	41	2.84	Lognormal	150	29	29
4,4'-DDE	15	18	48	2.73	Lognormal	190	76	76
4,4'-DDT	13	59	187	3.14	Lognormal	680	413	413
gamma-Chlordane	15	1	0.2	0.23	Normal	1.8	1.1	1.1
Dieldrin	13	10	23	2.38	Lognormal	86	41	41
Inorganics (mg/kg)								
Lead	12	15	3	0.21	Normal	21.5	17	17

ABBREVIATIONS

$\mu\text{g}/\text{kg}$ - micrograms per kilogram
 mg/kg - milligrams per kilogram

TABLE 8 - 5
SITE 2 SEDIMENT RISK ASSESSMENT DATA SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	NUMBER OF SAMPLES	AVG. CONC.	STD. DEV.	COEFF. OF VARIATION	NORMAL/ LOGNORMAL	MAX. CONC.	95TH UPPER CONF. LIMIT	EXPOSURE POINT CONC.
VOCs ($\mu\text{g/kg}$)								
Total Xylenes	6	4	2	0.46	Normal	3	6	3
SVOCs ($\mu\text{g/kg}$)								
Benzo(a)anthracene	6	190	13	0.07	Normal	170	202	170
Benzo(a)pyrene	6	198	14	0.07	Normal	220	211	211
Benzo(b)fluoranthene	6	213	48	0.23	Normal	310	257	257
Benzo(k)fluoranthene	6	188	16	0.09	Normal	160	203	160
Benzo(g,h,i)perylene	6	197	11	0.05	Normal	210	206	206
Carbazole	6	177	43	0.24	Normal	92	215	92
Chrysene	6	205	28	0.14	Normal	360	230	230
Dibenz(a,h)anthracene	6	171	57	0.33	Normal	56	222	56
Di-n-butylphthalate	6	146	78	0.53	Normal	54	217	54
Indeno(1,2,3-cd)pyrene	6	192	10	0.05	Normal	180	201	180
Fluoranthene	6	217	143	0.66	Normal	480	345	345
Phenanthrene	6	197	11	0.05	Normal	210	206	206
Pyrene	6	223	72	0.32	Normal	370	289	289
PEST/PCBs ($\mu\text{g/kg}$)								
4,4'-DDD	6	3.8	2.1	0.55	Normal	6.2	5.6	5.6
4,4'-DDE	6	6.4	6.3	0.99	Normal	18	12	12
4,4'-DDT	4	14	16	1.17	Lognormal	36	8691060	36
Dieldrin	5	21	36	1.75	Lognormal	86	2025	86

ABBREVIATIONS

$\mu\text{g/kg}$ - micrograms per kilogram

TABLE 8 - 6
SITE 2 GROUNDWATER RISK ASSESSMENT DATA SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	NUMBER OF SAMPLES	AVERAGE CONC.	STANDARD DEVIATION	COEFF. OF VARIATION	NORMAL/ LOGNORMAL	MAXIMUM CONC.	95TH UPPER CONF. LIMIT	EXPOSURE POINT CONC.
VOCs (µg/L)								
1,1-Dichloroethane	18	5	1	0.26	Normal	2	5	2
2-Butanone	18	5	1	0.27	Normal	3	5	3
1,2-Dichloroethene (total)	18	5	1	0.15	Normal	2	5	2
2-Hexanone	10	4	1	0.31	Normal	3	5	3
Carbon Disulfide	18	5	1	0.20	Normal	1	5	1
Chloroethane	18	5	1	0.21	Normal	2	5	2
4-Methyl-2-Pentanone	10	5	1	0.27	Normal	1	5	1
Acetone	9	5	0.3	0.07	Normal	5	5	5
Chloroform	18	5	1	0.22	Normal	4	5	4
Chloromethane	18	5	1	0.21	Normal	2	5	2
Ethylbenzene	18	8	6	0.76	Normal	22	11	11
Trichloroethene	18	5	1	0.20	Normal	4	5	4
Vinyl Chloride	18	5	2	0.34	Normal	7	5	5
SVOCs (µg/L)								
2-Methylnaphthalene	18	8	10	1.25	Lognormal	41	10	10
2,4-Dichlorophenol	18	6	1	0.22	Normal	9	6	6
Bis(2-ethylhexyl)phthalate	18	9	17	1.84	Lognormal	77	10	10
Dibenzofuran	18	4	2	0.36	Normal	2	5	2
Diethylphthalate	18	5	1	0.20	Normal	1	5	1
Di-n-butylphthalate	18	5	1	0.20	Normal	1	5	1
Di-n-octylphthalate	18	5	0.5	0.10	Normal	3	5	3
Fluorene	18	4	2	0.35	Normal	1	5	1
Naphthalene	18	14	20	1.38	Lognormal	72	27	27
Phenol	18	2	3	1.09	Lognormal	7	6	6

TABLE 8 - 6 (cont.)
SITE 2 GROUNDWATER RISK ASSESSMENT DATA SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	NUMBER OF SAMPLES	AVERAGE CONC.	STANDARD DEVIATION	COEFF. OF VARIATION	NORMAL/ LOGNORMAL	MAXIMUM CONC.	95TH UPPER CONF. LIMIT	EXPOSURE POINT CONC.
PEST/PCBs (µg/L)								
4,4'-DDD	18	2	3	1.53	Lognormal	10	63	10
4,4'-DDE	18	0.2	0.3	1.36	Lognormal	0.8	1	1
4,4'-DDT	18	2	3	1.43	Lognormal	11	41	11
alpha-Chlordane	17	0.02	0.004	0.18	Normal	0.007	0.03	0.007
Endrin	17	0.05	0.003	0.05	Normal	0.04	0.05	0.04
TOTAL METALS (µg/L)								
Aluminum	18	5259	9466	1.80	Lognormal	40400	34486	34486
Antimony	18	17	8	0.48	Normal	42.7	20	20
Arsenic	18	6	7	1.18	Lognormal	20.2	13	13
Barium	18	81	86	1.06	Lognormal	289	148	148
Beryllium	18	1	0.2	0.34	Normal	1.4	1	1
Cadmium	18	2	2	0.75	Normal	7.6	3	3
Calcium	18	124317	74829	0.60	Normal	211000	155696	155696
Chromium	18	11	13	1.21	Lognormal	55.4	14	14
Cobalt	18	7	8	1.10	Lognormal	36.1	10	10
Copper	18	20	22	1.11	Lognormal	96.6	33	33
Iron	18	11064	19391	1.75	Lognormal	80100	49577	49577
Lead	18	6	9	1.42	Lognormal	35	32	32
Magnesium	18	27129	13020	0.48	Normal	43500	32589	32589
Manganese	18	1483	1167	0.79	Normal	3250	1972	1972
Mercury	18	0.2	0.2	1.35	Lognormal	1	0.2	0.2
Nickel	18	19	18	0.95	Normal	78.1	27	27
Potassium	18	3008	1940	0.65	Normal	8400	3821	3821
Selenium	9	1	0	0.00	Normal	0.8	1	1
Silver	18	3	1	0.51	Normal	5.4	3	3
Sodium	18	46756	42376	0.91	Normal	133000	64526	64526
Thallium	18	1	0.2	0.40	Normal	1.3	1	1
Vanadium	18	20	25	1.25	Lognormal	99.8	47	47
Zinc	17	180	183	1.01	Lognormal	795	331	331
Cyanide	18	8	8	1.02	Lognormal	32	12	12

ABBREVIATIONS

µg/L - micrograms per liter

TABLE 8 - 7
SITE 2 CONTAMINANT OF POTENTIAL CONCERN SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	GROUNDWATER	ON-SITE SURFACE SOIL	OFF-SITE SURFACE SOIL	ALL SOIL
VOCs				
1,1-Dichloroethane	X			
2-Butanone	X			X
1,2-Dichloroethene (total)	X			
2-Hexanone	X			
Benzene				X
Carbon Disulfide	X			X
Chloroethane	X			
4-Methyl-2-Pentanone	X			
Acetone	X			
Chlorobenzene				X
Chloroform	X			X
Chloromethane	X			
Methylene Chloride		X		X
Toluene		X		X
Total Xylenes		X	X	X
Ethylbenzene	X			X
Trichloroethene	X			
Vinyl Chloride	X			
SVOCs				
2-Methylnaphthalene	X			X
2,4-Dichlorophenol	X			X
Bis(2-ethylhexyl)phthalate	X			X
Benzo(a)anthracene		X	X	X
Benzo(a)pyrene		X	X	X
Benzo(b)fluoranthene		X	X	X
Benzo(k)fluoranthene		X	X	X
Benzo(g,h,i)perylene		X	X	X
Carbazole		X	X	X
Chrysene		X	X	X
Dibenz(a,h)anthracene		X	X	X
Indeno(1,2,3-cd)pyrene		X	X	X
Fluoranthene		X	X	X
Phenanthrene		X	X	X
Pyrene		X	X	X
Dibenzofuran	X			
Diethylphthalate	X			
Di-n-butylphthalate	X	X	X	X
Di-n-octylphthalate	X			
Fluorene	X			
Naphthalene	X			X
Phenol	X			

TABLE 8 - 7 (cont.)
SITE 2 CONTAMINANT OF POTENTIAL CONCERN SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	GROUNDWATER	ON-SITE SURFACE SOIL	OFF-SITE SURFACE SOIL	ALL SOIL
PEST/PCBs				
4,4'-DDD	X	X	X	
4,4'-DDE	X	X	X	
4,4'-DDT	X	X	X	
alpha-Chlordane	X			
gamma-Chlordane		X		X
Dieldrin		X	X	X
Endrin	X			
TOTAL METALS				
Aluminum	X			
Antimony	X			
Arsenic	X			
Barium	X			
Beryllium	X			
Cadmium	X			
Calcium	X			
Chromium	X			
Cobalt	X			
Copper	X			
Iron	X			
Lead	X	X		
Magnesium	X			
Manganese	X			
Mercury	X			
Nickel	X			
Potassium	X			
Selenium	X			
Silver	X			
Sodium	X			
Thallium	X			
Vanadium	X			
Zinc	X			
Cyanide	X			

of 25 to 30 feet below grade. Groundwater is present in the overburden downslope of Site 2 at depths of 6 to 12 feet below grade. These shallow water bearing units were the focus of the field investigation, though these units do not produce sufficient water to serve as potable water sources.

There is some groundwater usage near the Base, though the Base and surrounding facilities are supplied by city water. All city water for Newburgh and New Windsor is obtained from surface water sources. Some private residences still use wells, with the nearest private well located just over 2,000 feet from Site 2. The depths of the private wells are unknown, though they are likely deeper than the monitoring wells at the site due to the low productivity of the weathered shale aquifer.

Stewart International Airport includes a number of landing strips, taxiways and airport support service areas, as well as the Stewart ANG Base facilities. The airport facilities are zoned for Industrial usage in the town of Newburgh, and Airport usage in New Windsor. The ANG Base facilities in Newburgh, NY are bounded on the west and northwest by Industrial Zones, and on the north and east by Interchange Business Zones. In New Windsor, the Base is bounded on the south and southwest by Airport Zones, on the southeast by Planned Industrial Zones, and to the east by Office and Light Industrial Zones. Residential housing is scattered throughout most of these areas. It is anticipated that future land use at the Base will be the same as current land use, as plans call for the Base to remain open for the foreseeable future.

Site 2 has unrestricted access and is located adjacent to a main access route on the ANG Base. The Stewart ANG Base Environmental Support Office and parking areas are located within close proximity to Sites 1 and 2, as well as a softball field. A recently-constructed automotive maintenance facility also exists adjacent to Site 2.

8.1.3.2 Identification of Exposure Pathways

The exposure pathway is a means of describing how an individual may become exposed to site contaminants. The exposure pathway links the contaminant source, location, and release mechanisms with population locations and activity patterns. A completed exposure pathway must have each of the following four elements, all of which must be present for exposure to occur:

- A source and mechanism for chemical release.
- An environmental transport medium.
- An exposure point.
- A human receptor and a feasible route of exposure at the exposure point.

The primary source of all contamination at Site 2 was the pesticide pit and the buried drums within the pit. This source was removed. The secondary sources at Site 2 are contaminated soils and sediment, which may serve as both sources and exposure points.

Figure 8-1 summarizes the exposure pathways considered in this BRA. Current and future land use scenarios are considered. Under the current land-use scenario, the exposed population includes on-site workers, trespassers/site visitors, and area residents (child and adult). The future land-use scenario assumes that the Base will be closed, and the site will become residential. Though this scenario is unlikely due to the proximity of the airport, it represents a worst-case scenario and is included here. Under this scenario, the exposed population includes on-site residents (child and adult).

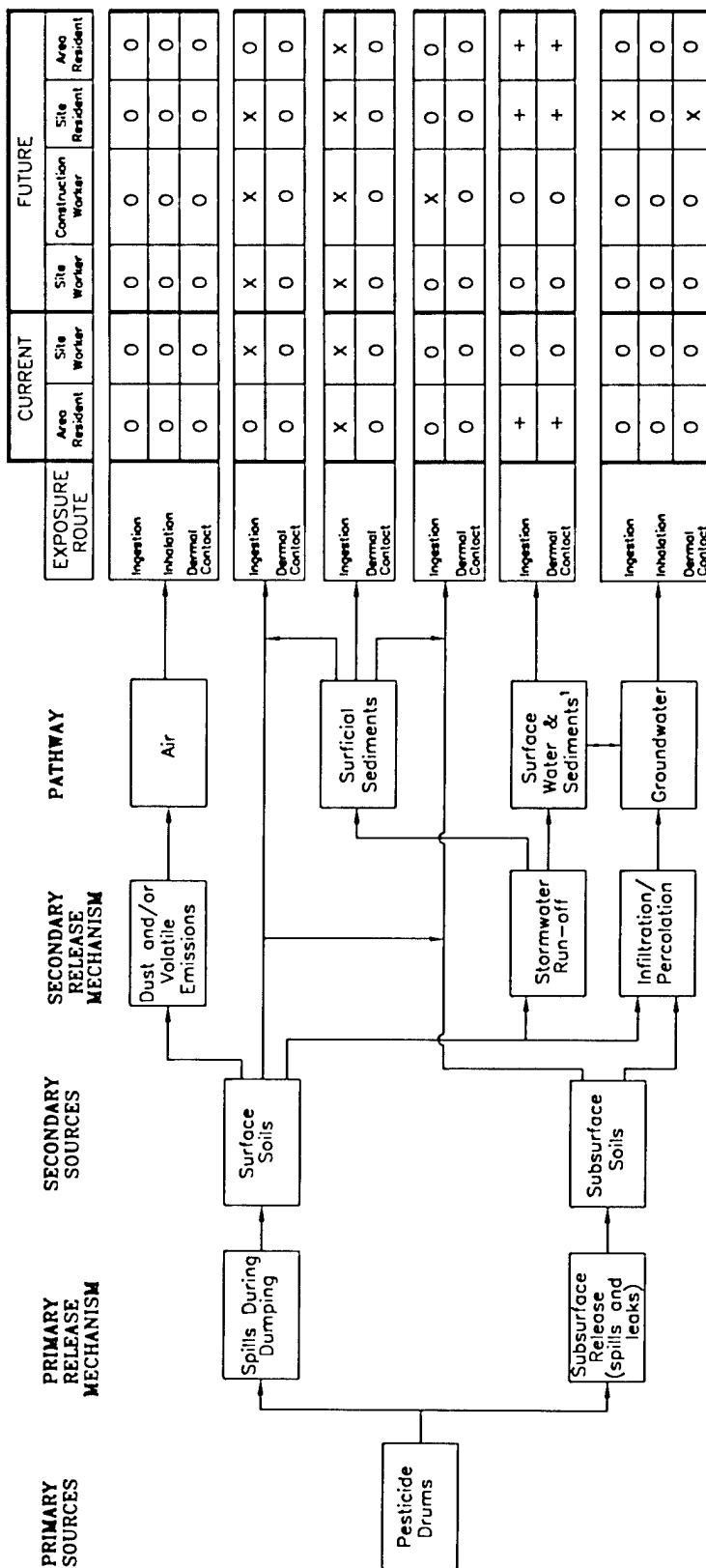
Based on the above descriptions of sources and receptor groups, the following exposure points were identified at Site 2:

- Contaminated soils in and around the former burial pit location. The potential receptors include current and future on-site workers, current and future trespassers/site visitors, future construction workers, and future on-site residents.
- Contaminated sediment in the drainage swales leading away from the site. Potential receptors include current and future on-site workers, current and future trespassers/site visitors, current and future area residents, future construction workers, and future on-site residents.
- Contaminated surface water in the drainage swales leading away from the site and in Murphy's Gulch. Potential receptors include current and future on-site workers, current and future trespassers/site visitors, current and future area residents, future construction workers, and future on-site residents.
- Airborne particulates containing site contaminants may be an exposure point for current and future on-site workers, current and future trespassers/site visitors, current and future area residents, future construction workers, and future on-site residents.
- The groundwater is a potential exposure point for future on-site residents. Also, groundwater-surface water connections may create an exposure point in surface drinking water supplies downgradient of the site.

Other future land-use scenarios which are more likely, include continued use as a Base, in which case the exposed populations would remain the same as the current, or a future light industrial use for the area, in which case a construction worker must be considered as a potential receptor.

The exposure pathways quantified are summarized in Table 8-8, and described in subsequent sections of the BRA, along with a discussion of the assumptions and calculations used to quantify the intake for each chemical and exposure pathway.

Note that several of the exposure pathways identified above were discounted as insignificant, and were not quantified. The following paragraphs describe each of the pathways not quantified and provide a rationale for the omission of the pathway.



LEGEND

- O - Pathway Discounted as Significant Risk
- X - Pathway Quantified in Risk Assessment
- + - Pathway Considered Qualitatively in Risk Assessment

NOTES:

- 1 - Submerged Sediment

STEWART AIR NATIONAL GUARD BASE RISK ASSESSMENT CONCEPTUAL SITE MODEL

NEWBURGH, NEW YORK



FIGURE: 8-1

TABLE 8 - 8
RISK ASSESSMENT CROSS REFERENCE
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

RECEPTOR	TABLE TYPE	RISK ASSESSMENT TABLE REFERENCE			
		SOIL EXPOSURES ¹		GROUNDWATER EXPOSURES	
		SURFACE SOIL/ SEDIMENT	SEDIMENT	ALL SOILS	INGESTION DERMAL CONTACT
On-Site Worker (current & future)	Data Exposure Risk	8-4 8-9 8-20			
Area Resident (current & future) Child Adult and 30-Year ²	Data Exposure Exposure Risk		8-5 8-10 8-11 8-21		
Construction Worker (future)	Data Exposure Risk			8-3 8-12 8-22	
On-Site Resident (future) Child Adult and 30-Year ²	Data Exposure Exposure Risk	8-4 8-13 8-14 8-23			8-6 8-15 8-16 8-24 8-6 NA 8-17 8-25

NOTES

1. All soil exposures are for ingestion only.
2. 30-year exposure combines 6 years of childhood exposure with 24 years of adult exposure.

No pathways were quantified for the site visitor/trespasser. The site visitor exposures are considered to be very similar to the site worker exposure, though the exposure magnitude would be far less due to the small amount of time spent on site by the site visitor. The magnitude of exposure for a site trespasser would also be far less than for a site worker. The site is within the fenced Base area. In addition, the site is an open field bordered on two sides by active Base facilities. It is unlikely that a trespasser could spend more than a few minutes on the site without being noticed and removed from the site. Even though these potentially exposed populations are not considered explicitly, the type of exposure is very similar to that of a site worker, with the site worker exposure providing a more conservative estimate of the risk.

None of the air pathways were quantified. The concentrations of volatiles in soils were very low. The maximum concentration detected was 25 $\mu\text{g/kg}$ of methylene chloride, while most detections were less than 10 $\mu\text{g/kg}$, which is the Contract Required Quantitation Limit (CRQL) for these VOCs. Therefore, the resulting airborne concentrations would be negligible. Inhalation of and dermal contact to dust was also not considered. For surface soils, the concentrations of all COPCs were low (e.g., no greater than 680 $\mu\text{g/kg}$), with most below the CRQL of 330 $\mu\text{g/kg}$, indicating a low potential for significant exposure. Exposures to surface soils are further reduced by the facts that the site is covered with grass, indicating low erosion potential, and is snow covered for most of the winter months. The potential for exposure to airborne dust is greater for construction workers exposed to subsurface soils. However, these workers also tend to wear more protective clothing. In addition, EPA's dermal exposure guidance lists only a small set of chemicals for which dermal exposures to soils can be accurately assessed (EPA, 1992). These chemicals are restricted to cadmium, PCBs, and dioxins, none of which are COPCs at Site 2.

The exposures to surface water were also not quantified. No surface water data was collected, as the drainage paths leading to Murphy's Gulch are dry much of the year. Sediment data was collected from the drainage swales leading to Murphy's Gulch, which allows for a semi-quantitative assessment of risks, which will be presented below. Also, as described above, the exposures to sediment considered in the risk assessment will be the same as for soils, since the sediments collected were from drainage areas which are dry much of the year.

There are a number of exposure pathways associated with surface water, of which the major mechanisms are dermal contact to surface water while swimming or wading, ingestion of surface water, either as a drinking water supply, or as incidental ingestion during swimming, and also ingestion of contaminated fish from the surface water. As described in Section 2.0, there are no surface water bodies near the site which support recreational or fishing activities, making it unlikely that these would be significant risk pathways. As described in Section 7.0, the ultimate destination of runoff and particulates is the wetland area around Murphy's Gulch, and the storm water pond associated with the closed New Windsor landfill. These sites are adjacent to the New York State Thruway, and do not support recreational activities.

The last exposure pathway not quantified is inhalation of groundwater. As shown on Table 8-6, the concentrations of volatiles detected in groundwater were very low (e.g., no greater than 22

μg/L), indicating that exposures from this pathway would be insignificant. In fact, most of the maximum detected concentrations were less than the 10 μg/L CRQL.

8.1.3.3 Quantification of Exposure

Ingestion of Soil - Ingestion of soil is a primary exposure pathway for a number of different populations. This pathway, via either on-site soils or on- or off-site sediments, may affect on-site workers, trespassers/site visitors, future construction workers, future on-site residents and current and future area residents. The average daily intake in milligrams per kilogram per day (mg/kg-day) is calculated as follows, with the results shown in Tables 8-9 through 8-14:

$$Intake \left(\frac{mg}{kg-day} \right) = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS	=	chemical concentration in soil, mg/kg soil
IR	=	ingestion rate of soil, mg soil/day
CF	=	conversion factor, 10 ⁻⁶ kg/mg
FI	=	fraction ingested from contaminated source, unitless
EF	=	exposure frequency, days/year
ED	=	exposure duration, years
BW	=	body weight, kg
AT	=	averaging time, days.

The chemical concentrations in soil are the exposure point concentrations described in Section 8.1.2.5. As necessary, the exposure point concentrations were converted to units of mg/kg. The ingestion rate varies, depending on the nature of the activities being conducted by the exposed individuals, and the age of the exposed individuals. For this risk assessment, values of 480 mg/day, 100 mg/day, and 200 mg/day will be used for site/construction workers, adult residents, and child residents, respectively (EPA, 1991a). The fraction ingested refers to the fraction of soil ingested by the exposed individual which comes from the contaminated soil at the site. For this risk assessment, a value of 1 will be used. This is extremely conservative, as it assumes that each exposed individual will be within the area of contamination during the entire exposure period. Site 2 is small, and it is unlikely that anyone would remain in contact with contaminated soils for any extended periods of time.

The exposure frequency is assumed to be 250 days/year for site workers, 150 days/year for construction workers, and 350 days/year for area residents. Again, these are conservative values. The 250 days/year and 350 days/year values do not account for snow cover or other inclement weather which would limit exposures to soils. The 150 days/year value for construction workers assumes that all construction work would occur within the small area of Site 2.

TABLE 8 - 9
CALCULATION OF INTAKE FROM INGESTION OF SURFACE SOIL/SEDIMENT
CURRENT/FUTURE SITE WORKER SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	EXPOSURE DURATION (years)	BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car								Nc	Car
VOCs											
Methylene Chloride	5E-09	2E-09	1.0E-03	480	1E-06	1	250	25	70	9125	25550
Toluene	1E-08	5E-09	3.0E-03	480	1E-06	1	250	25	70	9125	25550
Total Xylenes	2E-08	8E-09	4.6E-03	480	1E-06	1	250	25	70	9125	25550
SVOCs											
Di-n-butylphthalate	3E-07	9E-08	5.4E-02	480	1E-06	1	250	25	70	9125	25550
Benzo(a)anthracene	8E-07	3E-07	1.7E-01	480	1E-06	1	250	25	70	9125	25550
Benzo(a)pyrene	9E-07	3E-07	1.9E-01	480	1E-06	1	250	25	70	9125	25550
Benzo(b)fluoranthene	1E-06	4E-07	2.1E-01	480	1E-06	1	250	25	70	9125	25550
Benzo(k)fluoranthene	8E-07	3E-07	1.6E-01	480	1E-06	1	250	25	70	9125	25550
Benzo(g,h,i)perylene	9E-07	3E-07	1.9E-01	480	1E-06	1	250	25	70	9125	25550
Carbazole	4E-07	2E-07	9.2E-02	480	1E-06	1	250	25	70	9125	25550
Chrysene	9E-07	3E-07	2.0E-01	480	1E-06	1	250	25	70	9125	25550
Dibenz(a,h)anthracene	3E-07	9E-08	5.6E-02	480	1E-06	1	250	25	70	9125	25550
Indeno(1,2,3-cd)pyrene	8E-07	3E-07	1.8E-01	480	1E-06	1	250	25	70	9125	25550
Fluoranthene	1E-06	4E-07	2.3E-01	480	1E-06	1	250	25	70	9125	25550
Phenanthrene	9E-07	3E-07	1.9E-01	480	1E-06	1	250	25	70	9125	25550
Pyrene	1E-06	4E-07	2.1E-01	480	1E-06	1	250	25	70	9125	25550
Pesticides											
4,4'-DDD	1E-07	5E-08	2.9E-02	480	1E-06	1	250	25	70	9125	25550
4,4'-DDE	4E-07	1E-07	7.6E-02	480	1E-06	1	250	25	70	9125	25550
4,4'-DDT	2E-06	7E-07	4.1E-01	480	1E-06	1	250	25	70	9125	25550
gamma-Chlordane	5E-09	2E-09	1.1E-03	480	1E-06	1	250	25	70	9125	25550
Dieldrin	2E-07	7E-08	4.1E-02	480	1E-06	1	250	25	70	9125	25550

ABBREVIATIONS

Nc - noncarcinogenic
Car - carcinogenic
kg - kilograms
kg/mg - kilograms per milligram
mg/kg - milligrams per kilogram
mg/kg-day - milligrams per kilogram per day

TABLE 8 - 10
CALCULATION OF CHILD INTAKE FROM INGESTION OF SEDIMENT
CURRENT/FUTURE AREA RESIDENT SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHILD INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE - CHILD (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	CHILD EXPOSURE DURATION (years)	CHILD BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car								Child (Nc)	Car
VOCs											
Total Xylenes	4E-08	3E-09	3.0E-03	200	1E-06	1	350	6	15	2190	25550
SVOCs											
Benzo(a)anthracene	2E-06	2E-07	1.7E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(a)pyrene	3E-06	2E-07	2.1E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(b)fluoranthene	3E-06	3E-07	2.6E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(k)fluoranthene	2E-06	2E-07	1.6E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(g,h,i)perylene	3E-06	2E-07	2.1E-01	200	1E-06	1	350	6	15	2190	25550
Carbazole	1E-06	1E-07	9.2E-02	200	1E-06	1	350	6	15	2190	25550
Chrysene	3E-06	3E-07	2.3E-01	200	1E-06	1	350	6	15	2190	25550
Dibenz(a,h)anthracene	7E-07	6E-08	5.6E-02	200	1E-06	1	350	6	15	2190	25550
Di-n-butylphthalate	7E-07	6E-08	5.4E-02	200	1E-06	1	350	6	15	2190	25550
Indeno(1,2,3-cd)pyrene	2E-06	2E-07	1.8E-01	200	1E-06	1	350	6	15	2190	25550
Fluoranthene	4E-06	4E-07	3.5E-01	200	1E-06	1	350	6	15	2190	25550
Phenanthrene	3E-06	2E-07	2.1E-01	200	1E-06	1	350	6	15	2190	25550
Pyrene	4E-06	3E-07	2.9E-01	200	1E-06	1	350	6	15	2190	25550
Pesticides/PCBs											
4,4'-DDD	8E-08	7E-09	6.0E-03	200	1E-06	1	350	6	15	2190	25550
4,4'-DDE	2E-07	1E-08	1.2E-02	200	1E-06	1	350	6	15	2190	25550
4,4'-DDT	5E-07	4E-08	3.6E-02	200	1E-06	1	350	6	15	2190	25550
Dieldrin	1E-06	9E-08	8.6E-02	200	1E-06	1	350	6	15	2190	25550

ABBREVIATIONS

Nc - noncarcinogenic
Car - carcinogenic
kg - kilograms
kg/mg - kilograms per milligram
mg/kg - milligrams per kilogram
mg/kg-day - milligrams per kilogram per day

TABLE 8 - 11
CALCULATION OF ADULT AND 30-YEAR INTAKE FROM INGESTION OF SEDIMENT
CURRENT/FUTURE AREA RESIDENT SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHRONIC (30-YEAR) DAILY INTAKE ¹ (mg/kg-day)		ADULT INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE - ADULT (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	ADULT EXPOSURE DURATION (years)	ADULT BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car	Nc	Car								Adult (Nc)	Car
VOCs													
Total Xylenes	1.10E-08	1.78E-09	4E-09	1E-09	3.0E-03	100	1E-06	1	350	24	70	8760	25550
SVOCs													
Benzo(a)anthracene	6.21E-07	1.01E-07	2E-07	8E-08	1.7E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(a)pyrene	7.70E-07	1.25E-07	3E-07	1E-07	2.1E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(b)fluoranthene	9.38E-07	1.53E-07	4E-07	1E-07	2.6E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(k)fluoranthene	5.84E-07	9.52E-08	2E-07	8E-08	1.6E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(g,h,i)perylene	7.53E-07	1.23E-07	3E-07	1E-07	2.1E-01	100	1E-06	1	350	24	70	8760	25550
Carbazole	3.36E-07	5.47E-08	1E-07	4E-08	9.2E-02	100	1E-06	1	350	24	70	8760	25550
Chrysene	8.41E-07	1.37E-07	3E-07	1E-07	2.3E-01	100	1E-06	1	350	24	70	8760	25550
Dibenz(a,h)anthracene	2.03E-07	3.33E-08	8E-08	3E-08	5.6E-02	100	1E-06	1	350	24	70	8760	25550
Di-n-butylphthalate	1.97E-07	3.21E-08	7E-08	3E-08	5.4E-02	100	1E-06	1	350	24	70	8760	25550
Indeno(1,2,3-cd)pyrene	6.58E-07	1.07E-07	2E-07	8E-08	1.8E-01	100	1E-06	1	350	24	70	8760	25550
Fluoranthene	1.26E-06	2.05E-07	5E-07	2E-07	3.4E-01	100	1E-06	1	350	24	70	8760	25550
Phenanthrene	7.53E-07	1.23E-07	3E-07	1E-07	2.1E-01	100	1E-06	1	350	24	70	8760	25550
Pyrene	1.06E-06	1.72E-07	4E-07	1E-07	2.9E-01	100	1E-06	1	350	24	70	8760	25550
Pesticides/PCBs													
4,4'-DDD	2.15E-08	3.43E-09	8E-09	3E-09	5.6E-03	100	1E-06	1	350	24	70	8760	25550
4,4'-DDE	4.40E-08	7.18E-09	2E-08	6E-09	1.2E-02	100	1E-06	1	350	24	70	8760	25550
4,4'-DDT	1.32E-07	2.14E-08	5E-08	2E-08	3.6E-02	100	1E-06	1	350	24	70	8760	25550
Dieldrin	3.14E-07	5.12E-08	1E-07	4E-08	8.6E-02	100	1E-06	1	350	24	70	8760	25550

NOTES

1. Represents combined 24-year adult exposure and 6-year child exposure.

Nc - noncarcinogenic

Car - carcinogenic

kg - kilograms

kg/mg - kilograms per milligram

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

TABLE 8 - 12
CALCULATION OF INTAKE FROM INGESTION OF SOIL
FUTURE CONSTRUCTION WORKER SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	EXPOSURE DURATION (years)	BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car								Nc	Car
VOCs											
2-Butanone	8E-09	3E-09	3.0E-03	480	1E-06	1	150	25	70	9125	25550
Benzene	2E-08	6E-09	5.8E-03	480	1E-06	1	150	25	70	9125	25550
Carbon Disulfide	8E-09	3E-09	3.0E-03	480	1E-06	1	150	25	70	9125	25550
Chlorobenzene	8E-09	3E-09	3.0E-03	480	1E-06	1	150	25	70	9125	25550
Chloroform	6E-09	2E-09	2.0E-03	480	1E-06	1	150	25	70	9125	25550
Ethylbenzene	2E-08	7E-09	6.5E-03	480	1E-06	1	150	25	70	9125	25550
Methylene Chloride	2E-08	7E-09	6.6E-03	480	1E-06	1	150	25	70	9125	25550
Toluene	8E-09	3E-09	3.0E-03	480	1E-06	1	150	25	70	9125	25550
Total Xylenes	1E-08	5E-09	5.0E-03	480	1E-06	1	150	25	70	9125	25550
SVOCs											
2,4-Dichlorophenol	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
2-Methylphthalene	1E-06	4E-07	3.6E-01	480	1E-06	1	150	25	70	9125	25550
Bis(2-ethylhexyl)phthalate	2E-07	7E-08	7.2E-02	480	1E-06	1	150	25	70	9125	25550
Benzo(a)anthracene	5E-07	2E-07	1.7E-01	480	1E-06	1	150	25	70	9125	25550
Benzo(a)pyrene	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
Benzo(b)fluoranthene	6E-07	2E-07	2.0E-01	480	1E-06	1	150	25	70	9125	25550
Benzo(k)fluoranthene	5E-07	2E-07	1.6E-01	480	1E-06	1	150	25	70	9125	25550
Benzo(g,h,i)perylene	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
Carbazole	3E-07	9E-08	9.2E-02	480	1E-06	1	150	25	70	9125	25550
Chrysene	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
Dibenz(a,h)anthracene	2E-07	6E-08	5.6E-02	480	1E-06	1	150	25	70	9125	25550
Di-n-butylphthalate	2E-07	5E-08	5.4E-02	480	1E-06	1	150	25	70	9125	25550
Indeno(1,2,3-cd)pyrene	5E-07	2E-07	1.8E-01	480	1E-06	1	150	25	70	9125	25550
Fluoranthene	6E-07	2E-07	2.0E-01	480	1E-06	1	150	25	70	9125	25550
Naphthalene	1E-06	4E-07	3.7E-01	480	1E-06	1	150	25	70	9125	25550
Phenanthrene	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
Pyrene	5E-07	2E-07	1.9E-01	480	1E-06	1	150	25	70	9125	25550
Pesticides											
4,4'-DDD	9E-07	3E-07	3.2E-01	480	1E-06	1	150	25	70	9125	25550
4,4'-DDE	8E-08	3E-08	3.0E-02	480	1E-06	1	150	25	70	9125	25550
4,4'-DDT	4E-06	1E-06	1.3E+00	480	1E-06	1	150	25	70	9125	25550
alpha-Chlordane	4E-09	2E-09	1.5E-03	480	1E-06	1	150	25	70	9125	25550
gamma-Chlordane	5E-09	2E-09	1.9E-03	480	1E-06	1	150	25	70	9125	25550
Dieldrin	3E-08	1E-08	1.2E-02	480	1E-06	1	150	25	70	9125	25550

ABBREVIATIONS

Nc - noncarcinogenic
Car - carcinogenic
kg - kilograms
kg/mg - kilograms per milligram
mg/kg - milligrams per kilogram
mg/kg-day - milligrams per kilogram per day

TABLE 8 - 13
CALCULATION OF CHILD INTAKE FROM INGESTION OF SURFACE SOIL/SEDIMENT
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHILD INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE - CHILD (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	CHILD EXPOSURE DURATION (years)	CHILD BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car								Child (Nc)	Car
VOCs											
Methylene Chloride	1E-08	1E-09	1.0E-03	200	1E-06	1	350	6	15	2190	25550
Toluene	4E-08	3E-09	3.0E-03	200	1E-06	1	350	6	15	2190	25550
Total Xylenes	6E-08	5E-09	4.6E-03	200	1E-06	1	350	6	15	2190	25550
SVOCs											
Di-n-butylphthalate	7E-07	6E-08	5.4E-02	200	1E-06	1	350	6	15	2190	25550
Benzo(a)anthracene	2E-06	2E-07	1.7E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(a)pyrene	2E-06	2E-07	1.9E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(b)fluoranthene	3E-06	2E-07	2.1E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(k)fluoranthene	2E-06	2E-07	1.6E-01	200	1E-06	1	350	6	15	2190	25550
Benzo(g,h,i)perylene	2E-06	2E-07	1.9E-01	200	1E-06	1	350	6	15	2190	25550
Carbazole	1E-06	1E-07	9.2E-02	200	1E-06	1	350	6	15	2190	25550
Chrysene	3E-06	2E-07	2.0E-01	200	1E-06	1	350	6	15	2190	25550
Dibenz(a,h)anthracene	7E-07	6E-08	5.6E-02	200	1E-06	1	350	6	15	2190	25550
Indeno(1,2,3-cd)pyrene	2E-06	2E-07	1.8E-01	200	1E-06	1	350	6	15	2190	25550
Fluoranthene	3E-06	2E-07	2.3E-01	200	1E-06	1	350	6	15	2190	25550
Phenanthrene	2E-06	2E-07	1.9E-01	200	1E-06	1	350	6	15	2190	25550
Pyrene	3E-06	2E-07	2.1E-01	200	1E-06	1	350	6	15	2190	25550
Pesticides											
4,4'-DDD	4E-07	3E-08	2.9E-02	200	1E-06	1	350	6	15	2190	25550
4,4'-DDE	1E-06	8E-08	7.6E-02	200	1E-06	1	350	6	15	2190	25550
4,4'-DDT	5E-06	5E-07	4.1E-01	200	1E-06	1	350	6	15	2190	25550
gamma-Chlordane	1E-08	1E-09	1.1E-03	200	1E-06	1	350	6	15	2190	25550
Dieldrin	5E-07	4E-08	4.1E-02	200	1E-06	1	350	6	15	2190	25550

ABBREVIATIONS

Nc - noncarcinogenic
Car - carcinogenic
kg - kilograms
kg/mg - kilograms per milligram
mg/kg - milligrams per kilogram
mg/kg-day - milligrams per kilogram per day

TABLE 8 - 14

**CALCULATION OF ADULT AND 30-YEAR INTAKE FROM INGESTION OF SURFACE SOIL/SEDIMENT
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK**

ANALYTE	CHRONIC (30-YEAR) DAILY INTAKE ¹ (mg/kg-day)		ADULT INTAKE (mg/kg-day)		SOIL CONC. (mg/kg)	INGESTION RATE - ADULT (mg/day)	CONV. FACTOR (kg/mg)	FRACTION INGESTED (unitless)	EXPOSURE FREQUENCY (days/year)	ADULT EXPOSURE DURATION (years)	ADULT BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car	Nc	Car								Adult (Nc)	Car
VOCs													
Methylene Chloride	4E-09	6E-10	1E-09	5E-10	1.0E-03	100	1E-06	1	350	24	70	8760	25550
Toluene	1E-08	2E-09	4E-09	1E-09	3.0E-03	100	1E-06	1	350	24	70	8760	25550
Total Xylenes	2E-08	3E-09	6E-09	2E-09	4.6E-03	100	1E-06	1	350	24	70	8760	25550
SVOCs													
Di-n-butylphthalate	2E-07	3E-08	7E-08	3E-08	5.4E-02	100	1E-06	1	350	24	70	8760	25550
Benzo(a)anthracene	6E-07	1E-07	2E-07	8E-08	1.7E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(a)pyrene	7E-07	1E-07	3E-07	9E-08	1.9E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(b)fluoranthene	8E-07	1E-07	3E-07	1E-07	2.1E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(k)fluoranthene	6E-07	1E-07	2E-07	8E-08	1.6E-01	100	1E-06	1	350	24	70	8760	25550
Benzo(g,h,i)perylene	7E-07	1E-07	3E-07	9E-08	1.9E-01	100	1E-06	1	350	24	70	8760	25550
Carbazole	3E-07	5E-08	1E-07	4E-08	9.2E-02	100	1E-06	1	350	24	70	8760	25550
Chrysene	7E-07	1E-07	3E-07	9E-08	2.0E-01	100	1E-06	1	350	24	70	8760	25550
Dibenz(a,h)anthracene	2E-07	3E-08	8E-08	3E-08	5.6E-02	100	1E-06	1	350	24	70	8760	25550
Indeno(1,2,3-cd)pyrene	7E-07	1E-07	2E-07	8E-08	1.8E-01	100	1E-06	1	350	24	70	8760	25550
Fluoranthene	8E-07	1E-07	3E-07	1E-07	2.3E-01	100	1E-06	1	350	24	70	8760	25550
Phenanthrene	7E-07	1E-07	3E-07	9E-08	1.9E-01	100	1E-06	1	350	24	70	8760	25550
Pyrene	8E-07	1E-07	3E-07	1E-07	2.1E-01	100	1E-06	1	350	24	70	8760	25550
Pesticides													
4,4'-DDD	1E-07	2E-08	4E-08	1E-08	2.9E-02	100	1E-06	1	350	24	70	8760	25550
4,4'-DDE	3E-07	5E-08	1E-07	4E-08	7.6E-02	100	1E-06	1	350	24	70	8760	25550
4,4'-DDT	2E-06	2E-07	6E-07	2E-07	4.1E-01	100	1E-06	1	350	24	70	8760	25550
gamma-Chlordane	4E-09	7E-10	2E-09	5E-10	1.1E-03	100	1E-06	1	350	24	70	8760	25550
Dieldrin	1E-07	2E-08	6E-08	2E-08	4.1E-02	100	1E-06	1	350	24	70	8760	25550

ABBREVIATIONS

Nc - noncarcinogenic

Car - carcinogenic

kg - kilograms

kg/mg - kilograms per milligram

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

NOTES
1. Represents combined 24-year adult exposure and 6-year child exposure.

The exposure duration values are 25 years for all worker scenarios and 30 years for the residential scenarios. The 30 year residential exposure duration is further subdivided into 6 years of childhood exposure and 24 years of adult exposure. For the residential exposure scenarios, the chronic daily intake (CDI) in mg/kg-day is the weighted average of the child and adult intakes, and is calculated by:

$$Th_{e} CDI \left(\frac{mg}{kg-day} \right) = \frac{(Childhood\ Intake \left(\frac{mg}{kg-day} \right)) \times 6 + (Adult\ Intake \left(\frac{mg}{kg-day} \right)) \times 24}{30}$$

adult and chronic daily intakes are in Tables 8-11 and 8-14 for the current/future area residents and the future on-site residents, respectively. The child intakes are in Tables 8-10 and 8-13.

For body weight, values of 70 kg and 15 kg were used for the adult and child, respectively (EPA, 1991a). The averaging time used varied depending on the type of exposure. For noncarcinogenic affects, the averaging time was the same as the exposure duration, 25 years for worker scenarios and 30 years for residential scenarios. The 30 year residential exposure was split into 24 years of adult exposure and 6 years of childhood exposure. For carcinogenic affects, the averaging time used was an average lifetime, or 70 years (EPA, 1991a).

Ingestion of Groundwater - Ingestion of groundwater is a primary exposure pathway only for future on-site residents, where the worst-case assumption is that future residents will obtain their drinking water directly from the contaminated aquifer. This is a conservative assumption because the Base is currently supplied by city water, and the entire area is likely to remain on city water. The intake in mg/kg-day is calculated as follows, with the results shown in Tables 8-15 and 8-16:

$$Intake \left(\frac{mg}{kg-day} \right) = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

- CW = chemical concentration in water, mg/L
- IR = ingestion rate, liters/day
- EF = exposure frequency, days/year
- ED = exposure duration, years
- BW = body weight, kg
- AT = averaging time, days.

The chemical concentrations in groundwater are the exposure point concentrations derived as described in Section 8.1.2.5. As necessary, the exposure point concentrations were converted

TABLE 8 - 15
CALCULATION OF CHILD INTAKE FROM INGESTION OF GROUNDWATER
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHILD INTAKE (mg/kg-day)		GROUNDWATER CONC. (mg/L)	INGESTION RATE - CHILD (L/day)	EXPOSURE FREQUENCY (days/year)	CHILD EXPOSURE DURATION (years)	CHILD BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car						Child (Nc)	Car
VOCs									
1,1-Dichloroethane	1E-04	1E-05	0.002	1	350	6	15	2190	25550
2-Butanone	2E-04	2E-05	0.003	1	350	6	15	2190	25550
1,2-Dichloroethene (total)	1E-04	1E-05	0.002	1	350	6	15	2190	25550
2-Hexanone	2E-04	2E-05	0.003	1	350	6	15	2190	25550
Carbon Disulfide	6E-05	5E-06	0.001	1	350	6	15	2190	25550
Chloroethane	1E-04	1E-05	0.002	1	350	6	15	2190	25550
4-Methyl-2-Pentanone	6E-05	5E-06	0.001	1	350	6	15	2190	25550
Acetone	3E-04	3E-05	0.005	1	350	6	15	2190	25550
Chloroform	3E-04	2E-05	0.004	1	350	6	15	2190	25550
Chloromethane	1E-04	1E-05	0.002	1	350	6	15	2190	25550
Ethylbenzene	7E-04	6E-05	0.011	1	350	6	15	2190	25550
Trichloroethene	3E-04	2E-05	0.004	1	350	6	15	2190	25550
Vinyl Chloride	3E-04	3E-05	0.0051	1	350	6	15	2190	25550
SVOCs									
2-Methylnaphthalene	8E-04	7E-05	0.013	1	350	6	15	2190	25550
2,4-Dichlorophenol	4E-04	3E-05	0.0061	1	350	6	15	2190	25550
Bis(2-ethylhexyl)phthalate	7E-04	6E-05	0.0102	1	350	6	15	2190	25550
Dibenzofuran	1E-04	1E-05	0.002	1	350	6	15	2190	25550
Diethylphthalate	6E-05	5E-06	0.001	1	350	6	15	2190	25550
Di-n-butylphthalate	6E-05	5E-06	0.001	1	350	6	15	2190	25550
Di-n-octylphthalate	2E-04	2E-05	0.003	1	350	6	15	2190	25550
Fluorene	6E-05	5E-06	0.001	1	350	6	15	2190	25550
Naphthalene	2E-03	1E-04	0.0267	1	350	6	15	2190	25550
Phenol	4E-04	3E-05	0.0058	1	350	6	15	2190	25550
PEST/PCBs									
4,4'-DDD	6E-04	5E-05	0.0097	1	350	6	15	2190	25550
4,4'-DDE	4E-05	4E-06	0.0007	1	350	6	15	2190	25550
4,4'-DDT	7E-04	6E-05	0.011	1	350	6	15	2190	25550
alpha-Chlordane	4E-07	4E-08	7.00E-06	1	350	6	15	2190	25550
Endrin	2E-06	2E-07	0.000039	1	350	6	15	2190	25550

TABLE 8 - 15 (cont.)
 CALCULATION OF CHILD INTAKE FROM INGESTION OF GROUNDWATER
 FUTURE RESIDENTIAL SCENARIO
 STEWART AIR NATIONAL GUARD BASE
 NEWBURGH, NEW YORK

ANALYTE	CHILD INTAKE (mg/kg-day)		GROUNDWATER CONC. (mg/L)	INGESTION RATE - CHILD (L/day)	EXPOSURE FREQUENCY (days/year)	CHILD EXPOSURE DURATION (years)	CHILD BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car						Child (Nc)	Car
TOTAL METALS									
Aluminum	2E+00	2E-01	34.486	1	350	6	15	2190	25550
Antimony	1E-03	1E-04	0.0204	1	350	6	15	2190	25550
Arsenic	8E-04	7E-05	0.0125	1	350	6	15	2190	25550
Barium	9E-03	8E-04	0.148	1	350	6	15	2190	25550
Beryllium	4E-05	4E-06	0.0007	1	350	6	15	2190	25550
Cadmium	2E-04	2E-05	0.003	1	350	6	15	2190	25550
Calcium	1E+01	9E-01	155.7	1	350	6	15	2190	25550
Chromium	9E-04	8E-05	0.0143	1	350	6	15	2190	25550
Cobalt	6E-04	5E-05	0.01	1	350	6	15	2190	25550
Copper	2E-03	2E-04	0.033	1	350	6	15	2190	25550
Iron	3E+00	3E-01	49.577	1	350	6	15	2190	25550
Lead	2E-03	2E-04	0.0321	1	350	6	15	2190	25550
Magnesium	2E+00	2E-01	32.589	1	350	6	15	2190	25550
Manganese	1E+00	1E-01	19.72	1	350	6	15	2190	25550
Mercury	1E-05	1E-06	0.00018	1	350	6	15	2190	25550
Nickel	2E-03	1E-04	0.027	1	350	6	15	2190	25550
Potassium	2E-01	2E-02	3.821	1	350	6	15	2190	25550
Selenium	5E-05	4E-06	0.0008	1	350	6	15	2190	25550
Silver	2E-04	2E-05	0.0034	1	350	6	15	2190	25550
Sodium	4E+00	4E-01	64.526	1	350	6	15	2190	25550
Thallium	4E-05	4E-06	0.0007	1	350	6	15	2190	25550
Vanadium	3E-03	3E-04	0.0465	1	350	6	15	2190	25550
Zinc	2E-02	2E-03	0.33	1	350	6	15	2190	25550
Cyanide	8E-04	6E-05	0.0118	1	350	6	15	2190	25550

ABBREVIATIONS

Nc - noncarcinogenic

Car - carcinogenic

kg - kilograms

mg/L - milligrams per liter

L/day - liters per day

mg/kg-day - milligrams per kilogram per day

TABLE 8 - 16
CALCULATION OF ADULT AND 30-YEAR INTAKE FROM INGESTION OF GROUNDWATER
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHRONIC (30-YEAR) DAILY INTAKE ¹ (mg/kg-day)		ADULT INTAKE (mg/kg-day)		GROUNDWATER CONC. (mg/L)	INGESTION RATE - ADULT (L/day)	EXPOSURE FREQUENCY (days/year)	ADULT EXPOSURE DURATION (years)	ADULT BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car	Nc	Car						Adult (Nc)	Car
VOCs											
1,1-Dichloroethane	7E-05	2E-05	5E-05	2E-05	2.0E-03	2	350	24	70	8760	25550
2-Butanone	1E-04	3E-05	8E-05	3E-05	3.0E-03	2	350	24	70	8760	25550
1,2-Dichloroethene (total)	7E-05	2E-05	5E-05	2E-05	2.0E-03	2	350	24	70	8760	25550
2-Hexanone	1E-04	3E-05	8E-05	3E-05	3.0E-03	2	350	24	70	8760	25550
Carbon Disulfide	3E-05	9E-06	3E-05	9E-06	1.0E-03	2	350	24	70	8760	25550
Chloroethane	7E-05	2E-05	5E-05	2E-05	2.0E-03	2	350	24	70	8760	25550
4-Methyl-2-Pentanone	3E-05	9E-06	3E-05	9E-06	1.0E-03	2	350	24	70	8760	25550
Acetone	2E-04	4E-05	1E-04	5E-05	5.0E-03	2	350	24	70	8760	25550
Chloroform	1E-04	3E-05	1E-04	4E-05	4.0E-03	2	350	24	70	8760	25550
Chloromethane	7E-05	2E-05	5E-05	2E-05	2.0E-03	2	350	24	70	8760	25550
Ethylbenzene	4E-04	9E-05	3E-04	1E-04	1.1E-02	2	350	24	70	8760	25550
Trichloroethene	1E-04	3E-05	1E-04	4E-05	4.0E-03	2	350	24	70	8760	25550
Vinyl Chloride	2E-04	4E-05	1E-04	5E-05	5.1E-03	2	350	24	70	8760	25550
SVOCs											
2-Methylnaphthalene	5E-04	1E-04	4E-04	1E-04	1.3E-02	2	350	24	70	8760	25550
2,4-Dichlorophenol	2E-04	5E-05	2E-04	6E-05	6.1E-03	2	350	24	70	8760	25550
Bis(2-ethylhexyl)phthalate	4E-04	9E-05	3E-04	1E-04	1.0E-02	2	350	24	70	8760	25550
Dibenzofuran	7E-05	2E-05	5E-05	2E-05	2.0E-03	2	350	24	70	8760	25550
Diethylphthalate	3E-05	9E-06	3E-05	9E-06	1.0E-03	2	350	24	70	8760	25550
Di-n-butylphthalate	3E-05	9E-06	3E-05	9E-06	1.0E-03	2	350	24	70	8760	25550
Di-n-octylphthalate	1E-04	3E-05	8E-05	3E-05	3.0E-03	2	350	24	70	8760	25550
Fluorene	3E-05	9E-06	3E-05	9E-06	1.0E-03	2	350	24	70	8760	25550
Naphthalene	9E-04	2E-04	7E-04	3E-04	2.7E-02	2	350	24	70	8760	25550
Phenol	2E-04	5E-05	2E-04	5E-05	5.8E-03	2	350	24	70	8760	25550
PEST/PCBs											
4,4'-DDD	3E-04	8E-05	3E-04	9E-05	9.7E-03	2	350	24	70	8760	25550
4,4'-DDE	2E-05	6E-06	2E-05	7E-06	7.0E-04	2	350	24	70	8760	25550
4,4'-DDT	4E-04	9E-05	3E-04	1E-04	1.1E-02	2	350	24	70	8760	25550
alpha-Chlordane	2E-07	6E-08	2E-07	7E-08	7.0E-06	2	350	24	70	8760	25550
Endrin	1E-06	3E-07	1E-06	4E-07	3.9E-05	2	350	24	70	8760	25550

TABLE 8 - 16 (cont.)
CALCULATION OF ADULT AND 30-YEAR INTAKE FROM INGESTION OF GROUNDWATER
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CHRONIC (30-YEAR) DAILY INTAKE' (mg/kg-day)		ADULT INTAKE (mg/kg-day)		GROUNDWATER CONC. (mg/L)	INGESTION RATE - ADULT (L/day)	EXPOSURE FREQUENCY (days/year)	ADULT EXPOSURE DURATION (years)	ADULT BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car	Nc	Car						Adult (Nc)	Car
TOTAL METALS											
Aluminum	1E+00	3E-01	9E-01	3E-01	3.4E+01	2	350	24	70	8760	25550
Antimony	7E-04	2E-04	6E-04	2E-04	2.0E-02	2	350	24	70	8760	25550
Arsenic	4E-04	1E-04	3E-04	1E-04	1.3E-02	2	350	24	70	8760	25550
Barium	5E-03	1E-03	4E-03	1E-03	1.5E-01	2	350	24	70	8760	25550
Beryllium	2E-05	6E-06	2E-05	7E-06	7.0E-04	2	350	24	70	8760	25550
Cadmium	1E-04	3E-05	8E-05	3E-05	3.0E-03	2	350	24	70	8760	25550
Calcium	5E+00	1E+00	4E+00	1E+00	1.6E+02	2	350	24	70	8760	25550
Chromium	5E-04	1E-04	4E-04	1E-04	1.4E-02	2	350	24	70	8760	25550
Cobalt	3E-04	9E-05	3E-04	9E-05	1.0E-02	2	350	24	70	8760	25550
Copper	1E-03	3E-04	9E-04	3E-04	3.3E-02	2	350	24	70	8760	25550
Iron	2E+00	4E-01	1E+00	5E-01	5.0E+01	2	350	24	70	8760	25550
Lead	1E-03	3E-04	9E-04	3E-04	3.2E-02	2	350	24	70	8760	25550
Magnesium	1E+00	3E-01	9E-01	3E-01	3.3E+01	2	350	24	70	8760	25550
Manganese	7E-01	2E-01	5E-01	2E-01	2.0E+01	2	350	24	70	8760	25550
Mercury	6E-06	2E-06	5E-06	2E-06	1.8E-04	2	350	24	70	8760	25550
Nickel	9E-04	2E-04	7E-04	3E-04	2.7E-02	2	350	24	70	8760	25550
Potassium	1E-01	3E-02	1E-01	4E-02	3.8E+00	2	350	24	70	8760	25550
Selenium	3E-05	7E-06	2E-05	8E-06	8.0E-04	2	350	24	70	8760	25550
Silver	1E-04	3E-05	9E-05	3E-05	3.4E-03	2	350	24	70	8760	25550
Sodium	2E+00	6E-01	2E+00	6E-01	6.5E+01	2	350	24	70	8760	25550
Thallium	2E-05	6E-06	2E-05	7E-06	7.0E-04	2	350	24	70	8760	25550
Vanadium	2E-03	4E-04	1E-03	4E-04	4.7E-02	2	350	24	70	8760	25550
Zinc	1E-02	3E-03	9E-03	3E-03	3.3E-01	2	350	24	70	8760	25550
Cyanide	4E-04	1E-04	3E-04	1E-04	1.2E-02	2	350	24	70	8760	25550

ABBREVIATIONS

Nc - noncarcinogenic

Car - carcinogenic

kg - kilograms

mg/L - milligrams per liter

L/day - liters per day

mg/kg-day - milligrams per kilogram per day

NOTES
1. Represents combined 24-year adult exposure and 6-year child exposure.

to units of mg/L. The ingestion rate was assumed to be 2 L/day for adult residents and 1 L/day for child residents (EPA, 1991a).

The exposure frequency is assumed to be 350 days/year for area residents. The exposure duration values are 30 years for the residential scenario, which, as described above, is subdivided into 6 years of childhood exposure and 24 years of adult exposure. For the residential exposure scenarios, the CDI in mg/kg-day is the weighted average of the child and adult intakes. The adult and chronic daily intakes are in Table 8-16 and the child intakes are in Table 8-15.

For body weight, values of 70 kg and 15 kg were used for the adult and child, respectively (EPA, 1991a). The averaging time used varied depending on the type of exposure. For noncarcinogenic affects, the averaging time was the same as the exposure duration, 30 years which was split into 24 years for the adult exposure and 6 years for the childhood exposure. For carcinogenic affects, the averaging time used was an average lifetime, or 70 years (EPA, 1991a).

Dermal Contact to Groundwater - Dermal contact to groundwater is a primary exposure pathway only for future on-site residents, where the worst-case assumption is that future residents will obtain their wash water directly from the contaminated aquifer. This is a conservative assumption because the Base is currently supplied by city water, and the entire area is likely to remain on city water.

Dermal exposures were estimated in accordance with the most recent EPA guidance, the *Dermal Exposure Assessment: Principles and Applications* (EPA, 1992) handbook. The average daily absorbed dose in mg/kg-day is calculated as follows, with the results shown in Table 8-17:

$$AbsorbedDose \left(\frac{mg}{kg-day} \right) = \frac{DA_{event} \times EV \times EF \times ED \times A}{BW \times AT}$$

where:

DA _{event}	=	absorbed dose per event, mg/cm ² -event
EV	=	event frequency, events/day
EF	=	exposure frequency, days/year
ED	=	exposure duration, years
A	=	skin surface area available for contact, cm ²
BW	=	body weight, kg
AT	=	averaging time, days.

The event frequency is assumed to be 1 shower (or bath) per day. The exposure frequency is assumed to be 350 days/year for area residents and the exposure duration values are 30 years for the residential scenario as described above. For body weight a value of 70 kg was used.

TABLE 8 - 17
CALCULATION OF ABSORBED DOSE FROM DERMAL CONTACT TO GROUNDWATER WHILE BATHING
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	ABSORBED DOSE (mg/kg-day)		ABSORBED DOSE PER EVENT (mg/cm ² -event)	GROUNDWATER CONC. (mg/L)	SKIN SURF. AREA (cm ²)	PERM. CONSTANT (cm/hr)	TAU (hr)	t* (hr)	B	EXPOSURE TIME (hr/event)	EXPOSURE FREQUENCY (days/year)	EXPOSURE DURATION (years)	CONV. FACTOR (L/L/1000-cm ²)	BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car													Nc	Car
VOCs																
1,1-Dichloroethane	4E-06	2E-06	1E-08	2.0E-03	23000	8.90E-03	0.350	0.840	6.20E-03	0.2	350	30	1E-03	70	10950	25550
2-Butanone	6E-07	3E-07	2E-09	3.0E-03	23000	1.10E-03	0.240	0.580	1.90E-04	0.2	350	30	1E-03	70	10950	25550
1,2-Dichlorobenzene (total)	5E-06	2E-06	1E-08	2.0E-03	23000	1.00E-02	0.340	0.820	7.20E-03	0.2	350	30	1E-03	70	10950	25550
2-Hexanone	3E-06	1E-06	1E-08	3.0E-03	23000	4.45E-03	0.357	0.858	2.40E-03	0.2	350	30	1E-03	70	10950	25550
Carbon Disulfide	5E-06	2E-06	2E-08	1.0E-03	23000	2.40E-02	0.270	0.650	1.70E-02	0.2	350	30	1E-03	70	10950	25550
Chloroethane	3E-06	1E-06	9E-09	2.0E-03	23000	8.00E-03	0.220	0.520	2.70E-03	0.2	350	30	1E-03	70	10950	25550
4-Methyl-2-Pentanone	8E-07	3E-07	2E-09	1.0E-03	23000	3.30E-03	0.360	0.860	1.50E-03	0.2	350	30	1E-03	70	10950	25550
Acetone	5E-07	2E-07	2E-09	5.0E-03	23000	5.69E-04	0.198	0.475	5.75E-05	0.2	350	30	1E-03	70	10950	25550
Chloroform	1E-05	4E-06	3E-08	4.0E-03	23000	8.90E-03	0.470	1.100	9.30E-03	0.2	350	30	1E-03	70	10950	25550
Chloromethane	1E-06	6E-07	4E-09	2.0E-03	23000	4.20E-03	0.180	0.430	8.10E-04	0.2	350	30	1E-03	70	10950	25550
Ethylbenzene	2E-04	8E-05	6E-07	1.1E-02	23000	7.40E-02	0.390	1.300	1.40E-01	0.2	350	30	1E-03	70	10950	25550
Trichloroethene	2E-05	8E-06	6E-08	4.0E-03	23000	1.60E-02	0.550	1.300	2.60E-02	0.2	350	30	1E-03	70	10950	25550
Vinyl Chloride	7E-06	3E-06	2E-08	5.1E-03	23000	7.30E-03	0.210	0.510	2.30E-03	0.2	350	30	1E-03	70	10950	25550
SVOCs																
2-Methylnaphthalene	9E-04	4E-04	3E-06	1.3E-02	23000	2.16E-01	0.645	4.451	1.30	0.2	350	30	1E-03	70	10950	25550
2,4-Dichlorophenol	5E-05	2E-05	2E-07	6.1E-03	23000	2.30E-02	0.860	2.100	0.08	0.2	350	30	1E-03	70	10950	25550
Bis(2-ethylhexyl)phthalate	6E-04	3E-04	2E-06	1.0E-02	23000	3.30E-02	21.000	100.000	13.00	0.2	350	30	1E-03	70	10950	25550
Dibenzofuran	1E-04	5E-05	4E-07	2.0E-03	23000	1.51E-01	0.929	6.309	1.32	0.2	350	30	1E-03	70	10950	25550
Diethylphthalate	3E-06	1E-06	8E-09	1.0E-03	23000	4.80E-03	2.000	4.700	0.03	0.2	350	30	1E-03	70	10950	25550
Di-n-butylphthalate	3E-05	1E-05	8E-08	1.0E-03	23000	3.30E-02	4.300	29.000	1.30	0.2	350	30	1E-03	70	10950	25550
Di-n-octylphthalate	1E-01	6E-02	5E-04	3.0E-03	23000	2.68E+01	21.111	99.483	158000	0.2	350	30	1E-03	70	10950	25550
Fluorene	7E-05	3E-05	2E-07	1.0E-03	23000	1.77E-01	0.903	5.443	1.58	0.2	350	30	1E-03	70	10950	25550
Naphthalene	5E-04	2E-04	2E-06	2.7E-02	23000	6.90E-02	0.530	2.200	0.20	0.2	350	30	1E-03	70	10950	25550
Phenol	7E-06	3E-06	2E-08	5.8E-03	23000	5.50E-03	0.330	0.790	0.003	0.2	350	30	1E-03	70	10950	25550
PEST/PCBs																
4,4'-DDD	3E-03	1E-03	9E-06	9.7E-03	23000	2.80E-01	7.800	37.000	63	0.2	350	30	1E-03	70	10950	25550
4,4'-DDE	2E-04	8E-05	6E-07	7.0E-04	23000	2.40E-01	7.600	36.000	49	0.2	350	30	1E-03	70	10950	25550
4,4'-DDT	7E-03	3E-03	2E-05	1.1E-02	23000	4.30E-01	13.000	60.000	230	0.2	350	30	1E-03	70	10950	25550
alpha-Chlordane	8E-07	3E-07	2E-09	7.0E-06	23000	5.20E-02	28.000	130.000	35	0.2	350	30	1E-03	70	10950	25550
Endrin	1E-06	4E-07	3E-09	3.9E-05	23000	1.60E-02	18.000	94.000	3.6	0.2	350	30	1E-03	70	10950	25550

TABLE 8 - 17 (cont.)
CALCULATION OF ABSORBED DOSE FROM DERMAL CONTACT TO GROUNDWATER WHILE BATHING
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	ABSORBED DOSE (mg/kg-day)		ABSORBED DOSE PER EVENT (mg/cm ² -event)	GROUNDWATER CONC. (mg/L)	SKIN SURF. AREA (cm ²)	PERM. CONSTANT (cm/hr)	TAU (hr)	t* (hr)	B	EXPOSURE TIME (hr/event)	EXPOSURE FREQUENCY (days/year)	EXPOSURE DURATION (years)	CONV. FACTOR (1 L/1000cm ³)	BODY WEIGHT (kg)	AVERAGING TIME (days)	
	Nc	Car													Nc	Car
TOTAL METALS																
Aluminum	2E-03	9E-04	7E-06	3.4E+01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Antimony	1E-06	6E-07	4E-09	2.0E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Arsenic	8E-07	3E-07	3E-09	1.3E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Barium	9E-06	4E-06	3E-08	1.5E-01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Beryllium	4E-08	2E-08	1E-10	7.0E-04	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Cadmium	2E-07	8E-08	6E-10	3.0E-03	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Calcium	1E-02	4E-03	3E-05	1.6E+02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Chromium	9E-07	4E-07	3E-09	1.4E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Cobalt	6E-07	3E-07	2E-09	1.0E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Copper	2E-06	9E-07	7E-09	3.3E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Iron	3E-03	1E-03	1E-05	5.0E+01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Lead	2E-06	9E-07	6E-09	3.2E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Magnesium	2E-03	9E-04	7E-06	3.3E+01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Manganese	1E-03	5E-04	4E-06	2.0E+01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Mercury	1E-08	5E-09	4E-11	1.8E-04	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Nickel	2E-06	7E-07	5E-09	2.7E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Potassium	2E-04	1E-04	8E-07	3.8E+00	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Selenium	5E-08	2E-08	2E-10	8.0E-04	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Silver	2E-07	9E-08	7E-10	3.4E-03	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Sodium	4E-03	2E-03	1E-05	6.5E+01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Thallium	4E-08	2E-08	1E-10	7.0E-04	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Vanadium	3E-06	1E-06	9E-09	4.7E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Zinc	2E-05	9E-06	7E-08	3.3E-01	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550
Cyanide	7E-07	3E-07	2E-09	1.2E-02	23000	1.00E-03				0.2	350	30	1E-03	70	10950	25550

ABBREVIATIONS

Nc - noncarcinogenic

Car - carcinogenic

cm² - square centimeters

hr - hour

hr/event - hours per event

kg - kilograms

kg/mg - kilograms per milligram

mg/kg - milligrams per kilogram

mg/kg-day - milligrams per kilogram per day

mg/cm²-event - milligrams per square centimeter per event

The averaging time used varied depending on the type of exposure. For noncarcinogenic effects, the averaging time was the same as the exposure duration, 30 years. For carcinogenic effects, the averaging time used was an average lifetime, or 70 years (EPA, 1991a).

For the skin surface area, a value of 23,000 cm² was used to represent the entire adult body surface. This value is the default recommended by EPA's most recent risk guidance for adults.

The DA_{event} was calculated following the guidance provided by EPA.

For inorganics, the following steady-state model was used:

$$DA_{event} = K_p^w C_w t_{event}$$

where:

DA _{event}	=	absorbed dose per event, mg/cm ² -event
K _p ^w	=	permeability coefficient from water, cm/hr
C _w	=	concentration of chemical in water, mg/cm ³
t _{event}	=	duration of event, hr/event.

For inorganics, a default value of 0.001 cm/hr was used as the permeability coefficient. The chemical concentrations in groundwater are the exposure point concentrations derived as described in Section 8.1.2.5. As necessary, the exposure point concentrations were converted to units of mg/cm³. The event duration to be 12 minutes/event (0.2 hr/event) which corresponds to the 90th percentile shower duration (EPA, 1989).

For organics, non-steady-state conditions were assumed due to the short duration of the event, and a more complicated model was used. One of the following equations was used:

$$\text{If } t_{event} < t^*, \text{ then: } DA_{event} = 2K_p C_w \sqrt{\frac{6\tau t_{event}}{\pi}}$$

$$\text{If } t_{event} > t^*, \text{ then: } DA_{event} = K_p C_w \left[\frac{t_{event}}{1+B} + 2\tau \left[\frac{1+3B}{1+B} \right] \right]$$

where:

t*	=	time to achieve steady-state conditions, hour
τ	=	lag time between initial skin contact and steady-state conditions, hour
B	=	relative contribution of permeability coefficients in stratum corneum and

epidermis ($K_{ow}/10^4$), unitless.

The values for K_p , t^* , τ , and B are tabulated in the guidance for most of the COPCs. At Site 2, only acetone, 2-hexanone, 2-methylnaphthalene, dibenzofuran, di-n-octylphthalate, and fluorene were not included. For these compounds, the chemical-specific parameters were calculated using the following series of equations. First, the permeability coefficient was estimated by:

$$\text{Log } K_p = -2.72 + 0.71 \log K_{ow} - 0.0061MW$$

where:

K_{ow} = octanol-water partition coefficient
MW = molecular weight.

For the chemicals of interest, values for K_{ow} and MW were obtained from EPA's treatability database.

Chemical	K_{ow}	MW
acetone	5.75E-01	58.1
2-hexanone	2.40E+01	100.2
2-methylnaphthalene	1.30E+04	142.2
dibenzofuran	1.32E+04	168.2
di-n-octylphthalate	1.58E+09	390.6
fluorene	1.58E+04	166.2

B was calculated by:

$$B = \frac{K_{ow}}{10^4}$$

An intermediate parameter, D_{sc} was calculated as follows:

$$D_{sc} = l_{sc} 10^{-(2.72 + 0.0061MW)}$$

where:

D_{sc} = stratum corneum diffusion coefficient, cm^2/hour
 l_{sc} = thickness of stratum corneum, 10^{-3} cm.

τ was calculated as follows:

$$\tau = \frac{l_{sc}^2}{6D_{sc}}$$

t^* was calculated using one of the following equations:

$$\text{If } B \leq 0.1, \text{ then } t^* = 2.4\tau$$

$$\text{If } B \geq 1.17, \text{ then } t^* = 6(b - \sqrt{b^2 - c^2})\tau$$

where:

$$b = \frac{2}{\pi}(1 + B)^2 - c$$

and

$$c = \frac{1 + 3B}{3}$$

B values did not fall between 0.1 and 1.17; therefore, no other equations were necessary.

The final dermal exposure values are presented in Table 8-17.

8.1.4 Toxicity Assessment

The purpose of the toxicity assessment is to compile the toxicity data for the COPCs at the site. The source for this toxicity data was the *Integrated Risk Information System* (IRIS). Two different types of toxicity were evaluated, noncarcinogenic and carcinogenic. Noncarcinogenic effects were evaluated using reference doses (RfD). Carcinogenic effects were evaluated using slope factors. These values are described below and are included in Table 8-18.

8.1.4.1 Health Criteria for Noncarcinogenic Effects

For chemicals that exhibit noncarcinogenic (i.e., systemic) effects, an organisms' repair and detoxification capabilities must be exceeded by some critical concentration (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is seen. The threshold view holds that an organism can tolerate a range of exposures below some finite value without an appreciable risk of adverse effects. Typically, these values are provided for both chronic (long-term) and acute (short-term) exposures. Because the concentrations and exposures associated with Site 2 are low, only those values pertaining

TABLE 8 - 18
SUMMARY OF TOXICITY VALUES USED IN HUMAN HEALTH RISK ASSESSMENT
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	RfD (mg/kg-day)	ORAL CARC. SLOPE 1/(mg/kg-day)	RANK WT. OF EVIDENCE ¹	ANALYTE	RfD (mg/kg-day)	ORAL CARC. SLOPE 1/(mg/kg-day)	RANK WT. OF EVIDENCE ¹
VOCs				Pesticides/PCBs			
Acetone	0.1	NA	D	4,4'-DDD	NA	0.24	B2
2-Butanone	0.6	NA	D	4,4'-DDE	NA	0.34	B2
Benzene	0.1	0.029	A	4,4'-DDT	0.0005	0.34	B2
Carbon Disulfide	0.1	NA	NA	Chlordane	0.00006	1.3	B2
Chlorobenzene	0.02	NA	D	Dieldrin	0.00005	16	B2
Chloroethane	NA	NA	NA	Endrin	0.0003	NA	D
Chloroform	0.01	0.0061	B2				
Chloromethane	NA	NA	NA	Inorganics			
1,1-Dichloroethane	NA	NA	C	Aluminum	NA	NA	NA
1,2-Dichloroethene - trans	0.02	NA	NA	Antimony	0.0004	NA	NA
1,2-Dichloroethene - cis	NA	NA	D	Arsenic	0.0003	1.5	A
2-Hexanone	NA	NA	NA	Barium	0.07	NA	NA
Methylene Chloride	0.06	0.0075	B2	Beryllium	0.005	4.3	B2
4-Methyl-2-Pentanone	NA	NA	NA	Cadmium	0.0005 (water) 0.001 (food)	NA	B1
Toluene	0.2	NA	D	Calcium	NA	NA	NA
Trichloroethene	NA	NA	NA	Chromium (III)	1	NA	NA
Vinyl Chloride	NA	NA	NA	Chromium (VI)	0.005	NA	A
Xylene	2	NA	D	Cobalt	NA	NA	NA
Ethylbenzene	0.1	NA	D	Copper	NA	NA	D
				Iron	NA	NA	NA
SVOCs				Lead	NA	NA	B2
2,4-Dichlorophenol	0.003	NA	NA	Magnesium	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	Manganese	0.14	NA	NA
Di-n-butylphthalate	0.1	NA	D	Mercury	NA	NA	D
Benzo(a)anthracene	NA	0.73	B2	Nickel	0.02	NA	NA
Benzo(a)pyrene	NA	7.3	B2	Potassium	NA	NA	NA
Benzo(b)fluoranthene	NA	0.73	B2	Selenium	0.005	NA	D
Benzo(k)fluoranthene	NA	0.73	B2	Silver	0.005	NA	D
Benzo(g,h,i)perylene	NA	NA	D	Sodium	NA	NA	D
Di(2-ethylhexyl)phthalate	0.02	0.014	B2	Thallium	0.00009	NA	D
Carbazole	NA	NA	NA	Vanadium	NA	NA	NA
Chrysene	NA	0.073	B2	Zinc	0.3	NA	D
Dibenz(a,h)anthracene	NA	7.3	B2	Cyanide	0.02	NA	D
Di-n-octylphthalate	NA	NA	NA				
Indeno(1,2,3-cd)pyrene	NA	0.73	B2				
Fluorene	0.04	NA	D				
Fluoranthene	0.04	NA	D				
Naphthalene	NA	NA	D				
Phenanthrene	NA	NA	D				
Phenol	0.6	NA	D				
Pyrene	0.03	NA	D				
Dibenzofuran	NA	NA	NA				
Diethylphthalate	0.8	NA	D				

ABBREVIATIONS

RfD - Reference Dose
mg/kg-day - milligrams per kilogram per day
NA - not applicable
VOCs - volatile organic compounds
SVOCs - semivolatile organic compounds
PCBs - polychlorinated biphenyls
CARC - Carcinogenic
WT - Weight

NOTES

1. Weight of Evidence:
A - Human Carcinogen.
B1 - Probable Human Carcinogen based on epidemiological studies.
B2 - Probable Human Carcinogen based on animal studies.
C - Possible Human Carcinogen.
D - Not Classified

to chronic exposures will be considered in the human health risk evaluation.

The RfD is used to evaluate noncarcinogenic risks. These values are published by EPA, and are generally based on animal studies. EPA applies various uncertainty factors to these data in order to make them applicable to human health. RfDs are used for oral exposures and are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day).

In the human health risk assessment, it is also necessary to consider dermal exposures. Unfortunately, dermal reference toxicity values are generally unavailable for the COPCs. In the absence of specific values, dermal toxicity values are often estimated from oral toxicity values by assuming a ratio between the administered dose (oral exposure) and the absorbed dose (dermal exposure). In order to be conservative, this ratio is often assumed to be 100%, though this will likely overestimate the risk. This assumes that in the study used to determine the RfD, 100% of the chemical administered was adsorbed by the test subject.

8.1.4.2 Health Criteria for Carcinogenic Effects

For carcinogens, it is assumed that any exposure, no matter how small, can lead to cancer in an individual. This is the non-threshold theory of carcinogenesis. EPA's Carcinogen Assessment Group has developed slope factors (i.e., dose-response values) for estimating excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. These are typically conservative values, and are more likely to overestimate actual risks than underestimate the actual risks. Excess lifetime cancer risks are generally expressed in scientific notation, and represent probabilities. For example, an excess lifetime cancer risk of 1×10^{-6} represents a one in a million probability that an individual will develop cancer as a result of exposure to a carcinogenic chemical over a 70-year lifetime under specified conditions. EPA has recommended that a range of 1×10^{-4} to 1×10^{-6} be used as a target range for establishing remedial goals for Superfund sites.

In addition, there are varying degrees of confidence in the weight of evidence for the carcinogenicity of a given chemical. The EPA uses a system for characterizing the overall weight of evidence for a chemical's carcinogenicity based on the availability of animal, human, and other supportive data. The weight-of-evidence classification is an attempt to determine the likelihood that the chemical is a human carcinogen, and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for carcinogenicity: (1) the quality of evidence from human studies, (2) the quality of evidence from animal studies, which are combined into a characterization of the overall weight of evidence for human carcinogenicity, and (3) other supportive information which is assessed to determine whether the overall weight of evidence should be modified. EPA's classification of the overall weight of evidence includes the following five categories:

- **Group A, Human Carcinogen** - This category indicates that there is sufficient evidence from epidemiological studies to support a causal association between an agent and cancer.

- **Group B, Probable Human Carcinogen** - This category generally indicates that there is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).
- **Group C, Possible Human Carcinogen** - This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans.
- **Group D, Not Classified** - This category indicates that the evidence for carcinogenicity in animals is inadequate.
- **Group E, No Evidence of Carcinogenicity to Humans** - This category indicates that there is no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies.

Several of the COPCs at Site 2 have been classified as potential carcinogens by the EPA, and each of these has been assigned a carcinogenicity weight-of-evidence category. These chemicals are shown in Table 8-18.

Oral slope factors were used to evaluate carcinogenic risks. Slope factors are route-specific values derived only for chemicals that have been shown to cause an increased incidence of tumors in human and/or animal studies. Oral slope factors are expressed in units of risk per dose (mg/kg-day)⁻¹.

Slope factors were not available for all potentially carcinogenic PAHs. Therefore, slope factors were derived for those PAHs from benzo(a)pyrene using toxicity equivalence factors (TEFs). The slope factor for benzo(a)pyrene was selected as the base slope factor because there is a high degree of confidence with this value. TEFs use chemical structure similarities between benzo(a)pyrene and the other PAHs to predict the toxicity of these PAHs relative to benzo(a)pyrene. EPA has provided TEFs for PAHs (EPA, 1988b):

PAH	TEF	Resulting Slope Factor (mg/kg-day) ⁻¹
Benzo(a)anthracene	0.1	0.73
Benzo(b)fluoranthene	0.1	0.73
Benzo(k)fluoranthene	0.1	0.73
Dibenzo(a,h)anthracene	1.0	7.3
Chrysene	0.01	0.073
Indeno(1,2,3-cd)pyrene	0.1	0.73

As with the noncarcinogenic toxicity values, there is little data for dermal carcinogenicity. Therefore, oral slope factors were modified in order to estimate dermal slope factors. In the absence of specific data, a ratio of 100% absorption was used as a conservative estimate.

8.1.5 Risk Characterization

The final step in the human health risk evaluation is the risk characterization step, in which the exposure and toxicity characterizations are combined to determine quantitative and qualitative expressions of risk.

8.1.5.1 Noncarcinogenic Effects

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period with an RfD derived for a similar exposure period. The ratio of exposure to toxicity is called a hazard quotient (HQ) and is calculated as follows:

$$HQ = \frac{E}{RfD}$$

where:

HQ = Hazard Quotient
E = Exposure level, or intake
RfD = Reference Dose.

By using the threshold approach to noncarcinogenic toxicity, it follows that a HQ less than 1.0 implies that the threshold is not exceeded and noncarcinogenic effects are unlikely, while a HQ greater than 1.0 implies a potential for noncarcinogenic effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) is calculated for each pathway. The HI assumes that all HQs are additive at a site, and that simultaneous sub-threshold exposures to several chemicals could result in adverse health effects. The HI is calculated as follows:

$$HI = \sum \frac{E_i}{RfD_i} = \sum HQ_i$$

where:

HI = Hazard Index
 E_i = Exposure level for chemical i
 RfD_i = Reference Dose for chemical i
 HQ_i = Hazard Quotient for chemical i.

8.1.5.2 Carcinogenic Effects

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen, or the excess individual lifetime cancer risk. The slope factor is used to convert the estimated daily intake to the incremental cancer risk. It is assumed that the dose-response relationship is linear in the low-dose conditions present at most hazardous waste sites. Using this assumption, the following linear low-dose equation can be used for the risk assessment:

$$Risk = CDI \times SF$$

where:

Risk = the probability of an individual developing cancer, unitless
CDI = chronic daily intake over 70 years, mg/kg-day
SF = Slope Factor, (mg/kg-day)⁻¹.

Tabulated values of slope factors are typically based on animal studies, and tend to be conservative values. Therefore, carcinogenic risk estimates are generally upper bound estimates, meaning that the true cancer risk is not likely to exceed the predicted cancer risk.

Another important assumption in the risk assessment is that the cancer risks from simultaneous exposures to multiple chemicals are additive, and are calculated by the following:

$$Risk_T = \sum Risk_i$$

where:

Risk_T = Total cancer risk, unitless probability
Risk_i = Risk estimate for the *i*th substance, unitless probability

In reality, the interactive effects of multiple carcinogens is highly complex and not well understood, but the assumption of additive affects is reasonable in cases where the doses are low, no synergistic or antagonistic interactions occur, and similar endpoints are evaluated. These conditions typically apply at hazardous waste sites.

EPA guidance states that the target cleanup goals for hazardous waste sites should be an excess lifetime cancer risk in the range of 10⁻⁴ to 10⁻⁶.

8.1.5.3 Quantification of Risk

8.1.5.3.1 Summary of Site Risks

The quantitative human health risks are summarized in Figures 8-2 through 8-4 and Table 8-19. Risks are divided into two groups, current and future site use. These groups are further subdivided by receptor. Current receptors include site workers and area residents. Future receptors include site workers, construction workers, on-site residents, and area residents.

The HI for each current site receptor (Figure 8-2) is well below the EPA target of 1.0. The HI for site workers is 0.01, and the HI for area residents is 0.01. The cancer risks are 5×10^{-6} for the site worker and 2×10^{-6} for the area resident, which are within the EPA target range of 1×10^{-4} to 1×10^{-6} . The hazard indices for all future receptors (Figure 8-3), with the exception of the future residential scenario, are all well below the EPA target of 1.0. The HI for site workers is 0.01, the HI for area residents is 0.007, the HI for construction workers is 0.01, and the HI for future on-site residents is 23. As shown in Figure 8-4, almost all of the HI for future residents is attributable to groundwater (HI = 23). The HI from groundwater can be further subdivided into a HI of 10 which is attributable to ingestion of groundwater and 13 which is attributable to dermal contact to groundwater.

The breakdown of the cancer risks is similar to the breakdown of noncarcinogenic risks. Cancer risks for the on-site worker (5×10^{-6}), construction worker (3×10^{-6}), and area resident (2×10^{-6}) are all within the EPA target range of 1×10^{-4} to 1×10^{-6} . The cancer risk for the future on-site resident is 2×10^{-3} , almost all of which is attributable to ingestion of and dermal contact to groundwater.

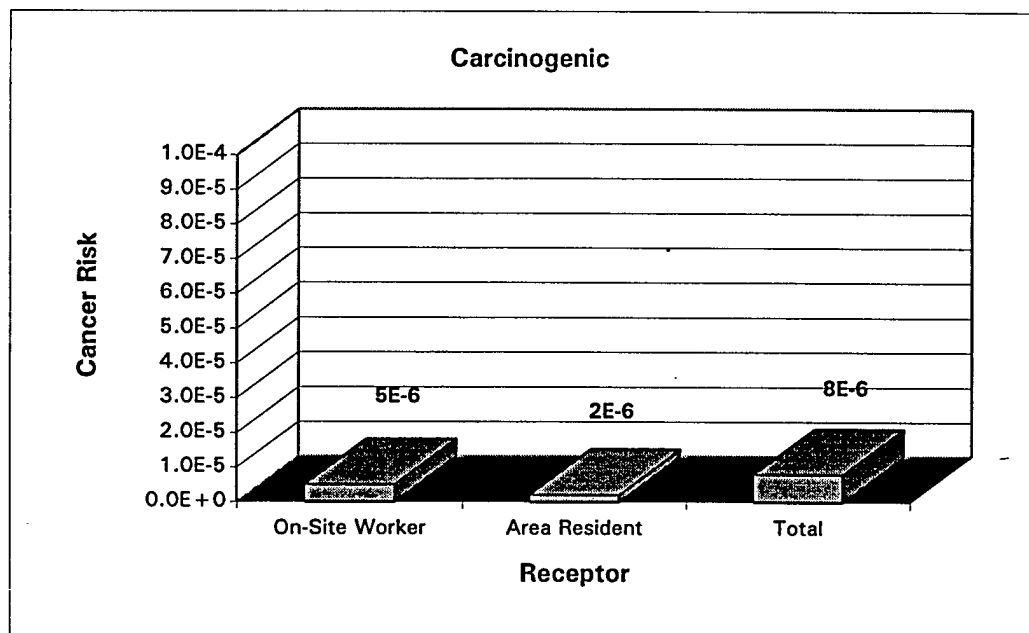
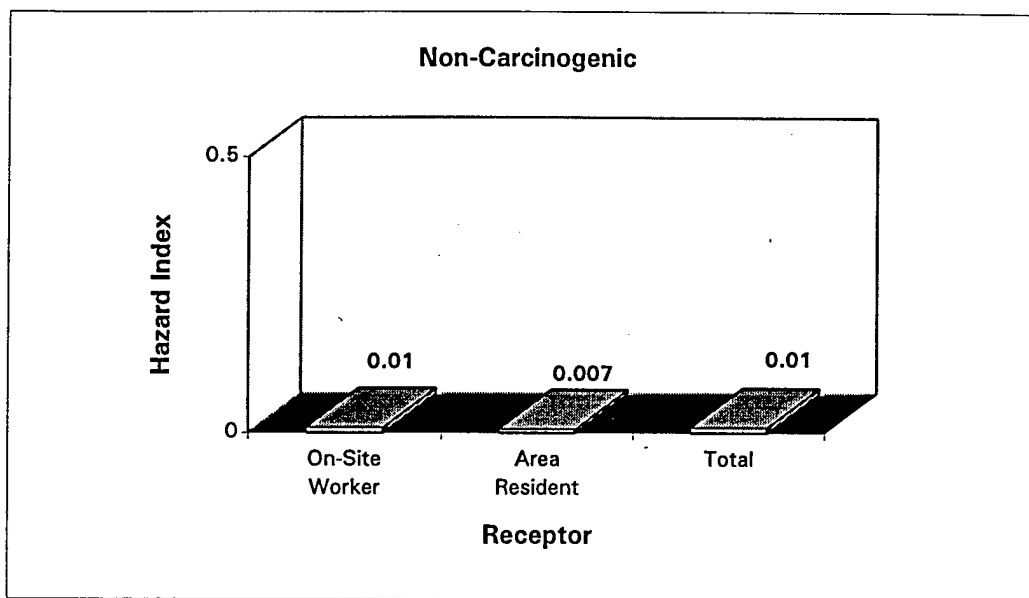
EPA's Biokinetic Uptake Model was run to evaluate lead risks at Site 2. The model results indicated that there are no unacceptable risks associated with lead.

More detailed discussions of each pathway's risks are provided below. Pathways for which there is no significant risk are not discussed.

8.1.5.3.2 Ingestion of Soil

The risk calculations for the various soil ingestion scenarios are presented in Tables 8-20 through 8-23. These tables present the COPC-specific HQs and total HI for all COPCs. These tables also present the COPC-specific and total excess cancer risks. Note that the CDIs (mg/kg-day)⁻¹ presented in these tables are the intakes calculated in the corresponding exposure tables. For the future residential scenario, the 30-year intake is used to represent a combined child and adult exposure.

The cancer risks for all soil scenarios were between 10^{-6} and 10^{-5} , which are within the EPA target range of 10^{-4} to 10^{-6} . The following paragraphs highlight the risk drivers associated with each pathway.



STEWART AIR NATIONAL GUARD BASE

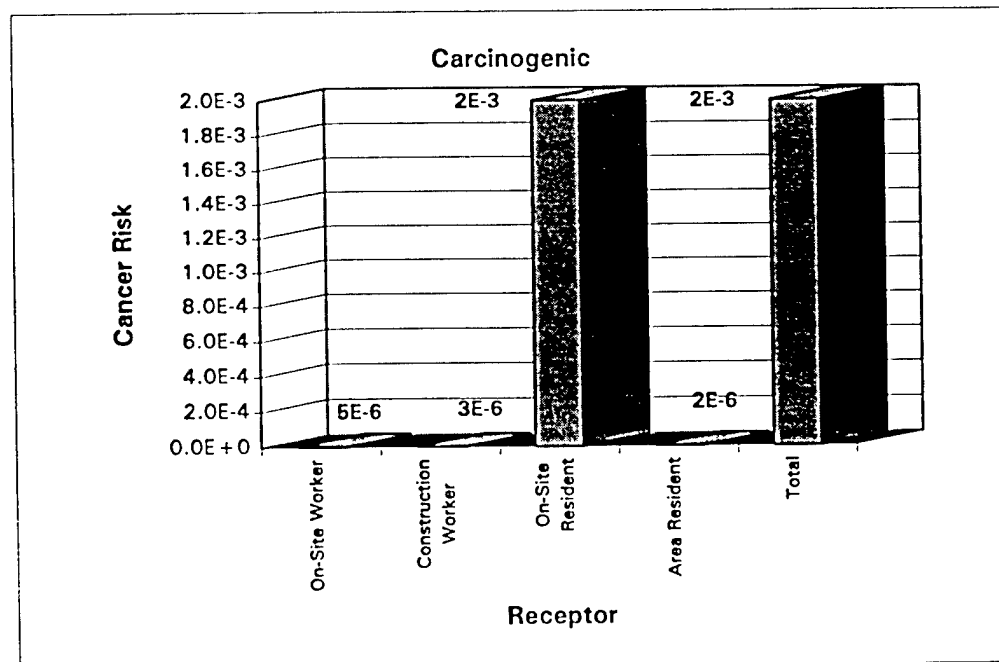
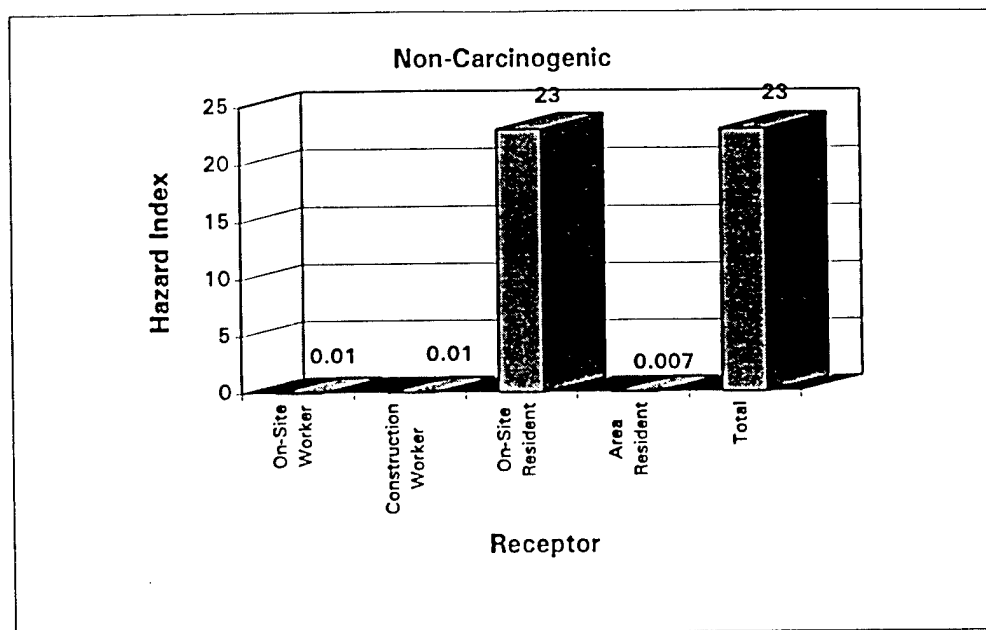
SUMMARY OF RISK ASSESSMENT FOR CURRENT RECEPTORS

NEWBURGH, NEW YORK



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and Process Technologies

FIGURE: 8-2



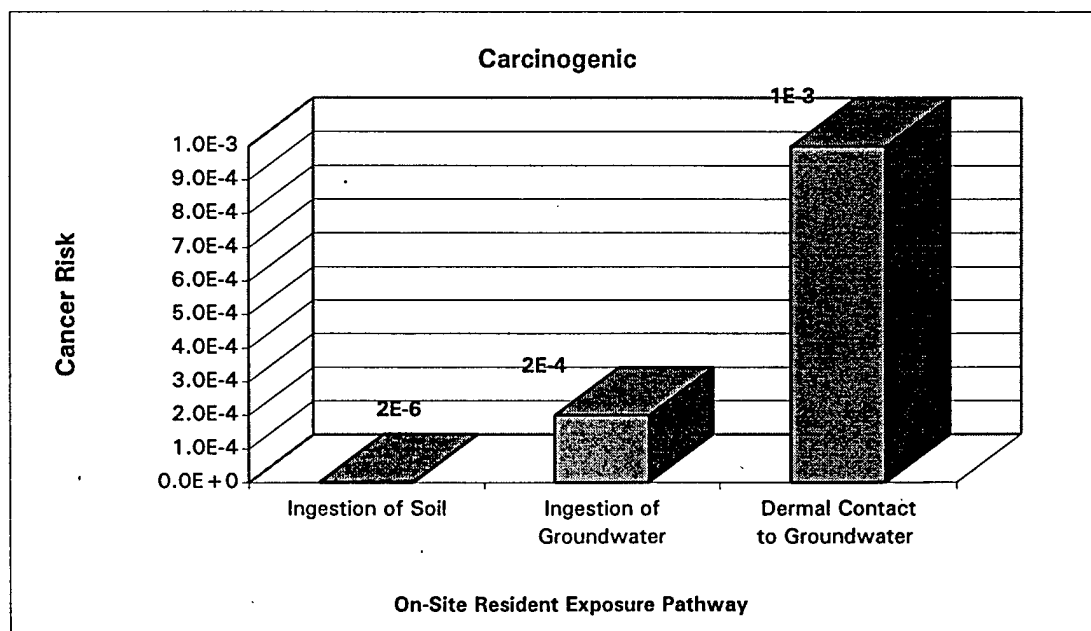
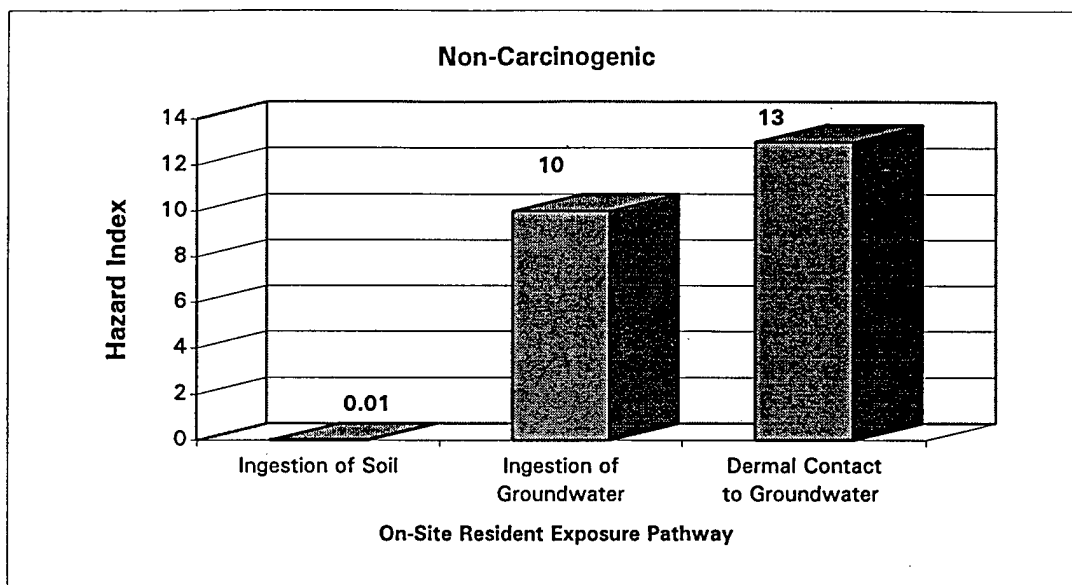
STEWART AIR NATIONAL GUARD BASE
SUMMARY OF RISK ASSESSMENT
FOR FUTURE RECEPTORS

NEWBURGH, NEW YORK



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FIGURE: 8-3



STEWART AIR NATIONAL GUARD BASE

SUMMARY OF RISK ASSESSMENT FOR FUTURE ON-SITE RECEPTORS

NEWBURGH, NEW YORK



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Analytic, Environmental
and Process Technologies

FIGURE: 8-4

TABLE 8 - 19
RISK ASSESSMENT RESULTS SUMMARY
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

RECEPTOR	EXPOSURE ROUTE	EXPOSURE ASSESSMENT TABLE NO.	RISK CHARACTERIZATION TABLE NO.	HAZARD INDEX	CANCER RISK
Current On-Site Worker	Ingestion of Surface Soil/Sediment	8 - 9	8 - 20	0.01	5E-06
Current Area Resident	Ingestion of Sediment	8 - 10, 8 - 11	8 - 21	0.007	2E-06
Total Current Use				0.01	8E-06
Future On-Site Worker	Ingestion of Surface Soil/Sediment	8 - 9	8 - 20	0.01	5E-06
Future Construction Worker	Ingestion of Soil/Sediment	8 - 12	8 - 22	0.01	3E-06
Future On-Site Resident	Ingestion of Surface Soil/Sediment Ingestion of Groundwater Dermal Contact to Groundwater Subtotal - Future On-Site Resident	8 - 13, 8 - 14 8 - 15, 8 - 16 8 - 17	8 - 23 8 - 24 8 - 25	0.01 10 13 23	2E-06 2E-04 1E-03 2E-03
Future Area Resident	Ingestion of Sediment	8 - 10, 8 - 11	8 - 21	0.007	2E-06
Total Future Use				23	2E-03

TABLE 8 - 20
CALCULATION OF RISK FROM INGESTION OF SURFACE SOIL/SEDIMENT
CURRENT/FUTURE SITE WORKER SCENARIO
STEWART AIR NATIONAL GUARD BASE

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
Methylene Chloride	5E-09	2E-09	0.06	0.0075	8E-08	1E-11
Toluene	1E-08		0.2		7E-08	
Total Xylenes	2E-08		2		1E-08	
SVOCs						
Di-n-butylphthalate	3E-07		0.1		3E-06	
Benzo(a)anthracene		3E-07		0.73		2E-07
Benzo(a)pyrene		3E-07		7.3		2E-06
Benzo(b)fluoranthene		4E-07		0.73		3E-07
Benzo(k)fluoranthene		3E-07		0.73		2E-07
Benzo(g,h,i)perylene						
Carbazole						
Chrysene		3E-07		0.073		2E-08
Dibenz(a,h)anthracene		9E-08		7.3		7E-07
Indeno(1,2,3-cd)pyrene		3E-07		0.73		2E-07
Fluoranthene	1E-06		0.04		3E-05	
Phenanthrene						
Pyrene	1E-06		0.03		3E-05	
Pesticides						
4,4'-DDD		5E-08		0.24		1E-08
4,4'-DDE		1E-07		0.34		4E-08
4,4'-DDT	2E-06	7E-07	0.0005	0.34	4E-03	2E-07
gamma-Chlordane	5E-09	2E-09	0.00006	1.3	9E-05	2E-09
Dieldrin	2E-07	7E-08	0.00005	16	4E-03	1E-06
Total HI and Car Risk					0.01	5E-06

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

TABLE 8 - 21
CALCULATION OF RISK FROM INGESTION OF SEDIMENT
CURRENT/FUTURE AREA RESIDENT SCENARIO
STEWART AIR NATIONAL GUARD BASE

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
Total Xylenes	1E-08		2	NA	5E-09	
SVOCs						
Benzo(a)anthracene		1E-07	NA	0.73		7E-08
Benzo(a)pyrene		1E-07	NA	7.3		9E-07
Benzo(b)fluoranthene		2E-07	NA	0.73		1E-07
Benzo(k)fluoranthene		1E-07	NA	0.73		7E-08
Benzo(g,h,i)perylene			NA	NA		
Carbazole						
Chrysene		1E-07	NA	0.073		1E-08
Dibenz(a,h)anthracene		3E-08	NA	7.3		2E-07
Di-n-butylphthalate	2E-07		0.1	NA	2E-06	
Indeno(1,2,3-cd)pyrene		1E-07	NA	0.73		8E-08
Fluoranthene	1E-06		0.04	NA	3E-05	
Phenanthrene			NA	NA		
Pyrene	1E-06		0.03	NA	4E-05	
Pesticides/PCBs						
4,4'-DDD		3E-09	NA	0.24		8E-10
4,4'-DDE		7E-09	NA	0.34		2E-09
4,4'-DDT	1E-07	2E-08	0.0005	0.34	3E-04	7E-09
Dieldrin	3E-07	5E-08	0.00005	16	6E-03	8E-07
Total HI and Car Risk					0.007	2E-06

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

TABLE 8 - 22
CALCULATION OF RISK FROM INGESTION OF SOIL
FUTURE CONSTRUCTION WORKER SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
2-Butanone	8E-09		0.6		1E-08	
Benzene	2E-08	6E-09	0.1	0.029	2E-07	2E-10
Carbon Disulfide	8E-09		0.1		8E-08	
Chlorobenzene	8E-09		0.02		4E-07	
Chloroform	6E-09	2E-09	0.01	0.0061	6E-07	1E-11
Ethylbenzene	2E-08		0.1		2E-07	
Methylene Chloride	2E-08	7E-09	0.06	0.0075	3E-07	5E-11
Toluene	8E-09		0.2		4E-08	
Total Xylenes	1E-08		2		7E-09	
SVOCs						
2,4-Dichlorophenol	5E-07		0.003		2E-04	
2-Methylaphthalene						
Bis(2-ethylhexyl)phthalate	2E-07	7E-08	0.02	0.014	1E-05	1E-09
Benzo(a)anthracene		2E-07		0.73		1E-07
Benzo(a)pyrene		2E-07		7.3		1E-06
Benzo(b)fluoranthene		2E-07		0.73		1E-07
Benzo(k)fluoranthene		2E-07		0.73		1E-07
Benzo(g,h,i)perylene						
Carbazole						
Chrysene		2E-07		0.073		1E-08
Dibenz(a,h)anthracene		6E-08		7.3		4E-07
Di-n-butylphthalate	2E-07		0.1		2E-06	
Indeno(1,2,3-cd)pyrene		2E-07		0.73		1E-07
Fluoranthene	6E-07		0.04		1E-05	
Naphthalene						
Phenanthrene						
Pyrene	5E-07		0.03		2E-05	
Pesticides						
4,4'-DDD		3E-07		0.24		8E-08
4,4'-DDE		3E-08		0.34		1E-08
4,4'-DDT	4E-06	1E-06	0.0005	0.34	7E-03	4E-07
alpha-Chlordane	4E-09	2E-09	0.00006	1.3	7E-05	2E-09
gamma-Chlordane						
Dieldrin	3E-08	1E-08	0.00005	16	7E-04	2E-07
Total HI and Car Risk					0.01	3E-06

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

TABLE 8 - 23
CALCULATION OF RISK FROM INGESTION OF SURFACE SOIL/SEDIMENT
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
Methylene Chloride	4E-09	6E-10	0.06	0.0075	6E-08	4E-12
Toluene	1E-08		0.2		5E-08	
Total Xylenes	2E-08		2		8E-09	
SVOCs						
Di-n-butylphthalate	2E-07		0.1		2E-06	
Benzo(a)anthracene		1E-07		0.73		7E-08
Benzo(a)pyrene		1E-07		7.3		8E-07
Benzo(b)fluoranthene		1E-07		0.73		9E-08
Benzo(k)fluoranthene		1E-07		0.73		7E-08
Benzo(g,h,i)perylene						
Carbazole						
Chrysene		1E-07		0.073		9E-09
Dibenz(a,h)anthracene		3E-08		7.3		2E-07
Indeno(1,2,3-cd)pyrene		1E-07		0.73		8E-08
Fluoranthene	8E-07		0.04		2E-05	
Phenanthrene						
Pyrene	8E-07		0.03		3E-05	
Pesticides						
4,4'-DDD		2E-08		0.24		4E-09
4,4'-DDE		5E-08		0.34		2E-08
4,4'-DDT	2E-06	2E-07	0.0005	0.34	3E-03	8E-08
gamma-Chlordane	4E-09	7E-10	0.00006	1.3	7E-05	9E-10
Dieldrin	1E-07	2E-08	0.00005	16	3E-03	4E-07
Total HI and Car Risk					0.01	2E-06

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

Table 8-20 presents the risks to the current/future site worker. The primary risk drivers are benzo(a)pyrene (2×10^{-6}) and dieldrin (1×10^{-6}). Secondary risk drivers were benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and 4,4'-DDT, all of which had cancer risks of approximately 2×10^{-7} . The risks from benzo(a)anthracene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, and dieldrin were calculated using maximum concentrations, while the other risks were calculated using 95th UCL concentrations. The maximum detected concentration for the four PAHs and dieldrin were found in sediment sample SS-04, located outside of the fenced Base area.

Table 8-21 provides the risks for the current/future area residents exposed to the sediment samples. As discussed previously, these are exposed sediments, and have been treated in the same manner as surface soil samples for the risk assessment. The primary cancer risk drivers for this scenario are benzo(a)pyrene (9×10^{-7}), dibenz(a,h)anthracene (2×10^{-7}), and dieldrin (8×10^{-7}). The risks from dibenz(a,h)anthracene, and dieldrin were calculated using maximum concentrations, while the risks from benzo(a)pyrene were calculated using the 95th UCL concentration. The maximum detected concentrations for dibenz(a,h)anthracene and dieldrin were found in sediment sample SS-04, located outside of the fenced Base area.

Table 8-22 provides the risks for the future construction worker scenario. The primary cancer risk driver for this scenario is benzo(a)pyrene (1×10^{-6}). The secondary risk drivers are benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, 4,4'-DDT, and dieldrin, all of which had cancer risks of between 1×10^{-7} and 5×10^{-7} . As described above, the risks from benzo(a)anthracene, benzo(k)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and dieldrin, were calculated using maximum concentrations, while the other risks were calculated using 95th UCL concentrations. The maximum detected concentration for these compounds were found in sediment sample SS-04, located outside of the fenced Base area.

Table 8-23 provides the results for the future residential scenario. The primary risk drivers are benzo(a)pyrene (8×10^{-7}), dibenz(a,h)anthracene (2×10^{-7}), and dieldrin (4×10^{-7}). The concentrations used in the risk assessment are the same as those used for the site worker scenario described previously.

8.1.5.3.3 Groundwater Risks

Tables 8-24 and 8-25 present the risks associated with site groundwater. Table 8-24 addresses the risks from groundwater ingestion, and Table 8-25 addresses dermal contact to groundwater. Both of these scenarios are part of a future residential exposure pathway, as there is no current or anticipated groundwater use at Site 2. Note that the CDIs (mg/kg-day)⁻¹ presented in these tables are the intakes calculated in the corresponding exposure tables. For the future residential scenario, the 30-year intake is used to represent a combined child and adult exposure.

The HI for the groundwater ingestion scenario (Table 8-24) is 9.68, which exceeds the EPA

TABLE 8 - 24
CALCULATION OF RISK FROM INGESTION OF GROUNDWATER
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
1,1-Dichloroethane						
2-Butanone	1E-04		0.6		2E-04	
1,2-Dichloroethene (total)	7E-05		0.02		3E-03	
2-Hexanone						
Carbon Disulfide	3E-05		0.1		3E-04	
Chloroethane						
4-Methyl-2-Pentanone						
Acetone	2E-04		0.1		2E-03	
Chloroform	1E-04	3E-05	0.01	0.0061	1E-02	2E-07
Chloromethane						
Ethylbenzene	4E-04		0.1		4E-03	
Trichloroethene						
Vinyl Chloride						
SVOCs						
2-Methylnaphthalene						
2,4-Dichlorophenol	2E-04		0.003		7E-02	
Bis(2-ethylhexyl)phthalate	4E-04	9E-05	0.02	0.014	2E-02	1E-06
Dibenzofuran						
Diethylphthalate	3E-05		0.8		4E-05	
Di-n-butylphthalate	3E-05		0.1		3E-04	
Di-n-octylphthalate						
Fluorene	3E-05		0.04		9E-04	
Naphthalene						
Phenol	2E-04		0.6		3E-04	
PEST/PCBs						
4,4'-DDD		8E-05		0.24		2E-05
4,4'-DDE		6E-06		0.34		2E-06
4,4'-DDT	4E-04	9E-05	0.0005	0.34	8E-01	3E-05
alpha-Chlordane	2E-07	6E-08	0.00006	1.3	4E-03	8E-08
Endrin	1E-06		0.0003		5E-03	

TABLE 8 - 24 (cont.)
CALCULATION OF RISK FROM INGESTION OF GROUNDWATER
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
TOTAL METALS						
Aluminum						
Antimony	7E-04		0.0004		2E+00	
Arsenic	4E-04	1E-04	0.0003	1.5	1E+00	2E-04
Barium	5E-03		0.07		7E-02	
Beryllium	2E-05	6E-06	0.005	4.3	5E-03	3E-05
Cadmium	1E-04		0.0005		2E-01	
Calcium						
Chromium	5E-04		1		5E-04	
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese	7E-01		0.14		5E+00	
Mercury						
Nickel	9E-04		0.02		5E-02	
Potassium						
Selenium	3E-05		0.005		6E-03	
Silver	1E-04		0.005		2E-02	
Sodium						
Thallium	2E-05		0.00009		3E-01	
Vanadium						
Zinc	1E-02		0.3		4E-02	
Cyanide	4E-04		0.02		2E-02	
Total HI and Car Risk					10	2E-04

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

TABLE 8 - 25
CALCULATION OF RISK OF FROM DERMAL CONTACT TO GROUNDWATER WHILE BATHING
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
VOCs						
1,1-Dichloroethane						
2-Butanone	6E-07		0.6		1E-06	
1,2-Dichloroethene (total)	5E-06		0.02		2E-04	
2-Hexanone						
Carbon Disulfide	5E-06		0.1		5E-05	
Chloroethane						
4-Methyl-2-Pentanone						
Acetone	5E-07		0.1		5E-06	
Chloroform	1E-05	4E-06	0.01	0.0061	1E-03	2E-08
Chloromethane						
Ethylbenzene	2E-04		0.1		2E-03	
Trichloroethene						
Vinyl Chloride						
SVOCs						
2-Methylnaphthalene						
2,4-Dichlorophenol	5E-05		0.003		2E-02	
Bis(2-ethylhexyl)phthalate	6E-04	3E-04	0.02	0.014	3E-02	4E-06
Dibenzofuran						
Diethylphthalate	3E-06		0.8		3E-06	
Di-n-butylphthalate	3E-05		0.1		3E-04	
Di-n-octylphthalate						
Fluorene	7E-05		0.04		2E-03	
Naphthalene						
Phenol	7E-06		0.6		1E-05	
PEST/PCBs						
4,4'-DDD		1E-03		0.24		3E-04
4,4'-DDE		8E-05		0.34		3E-05
4,4'-DDT	7E-03	3E-03	0.0005	0.34	1E+01	1E-03
alpha-Chlordane	8E-07	3E-07	0.00006	1.3	1E-02	4E-07
Endrin	1E-06		0.0003		3E-03	

TABLE 8 - 25 (cont.)
CALCULATION OF RISK OF FROM DERMAL CONTACT TO GROUNDWATER WHILE BATHING
FUTURE RESIDENTIAL SCENARIO
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	CDI ¹ Nc (mg/kg-day)	CDI ¹ Car (mg/kg-day)	RfD (mg/kg-day)	ORAL SLOPE FACTOR (mg/kg-day) ⁻¹	HAZARD QUOTIENT	CANCER RISK
TOTAL METALS						
Aluminum						
Antimony	1E-06		0.0004		3E-03	
Arsenic	8E-07	3E-07	0.0003	1.5	3E-03	5E-07
Barium	9E-06		0.07		1E-04	
Beryllium	4E-08	2E-08	0.005	4.3	9E-06	8E-08
Cadmium	2E-07		0.0005		4E-04	
Calcium						
Chromium	9E-07		1		9E-07	
Cobalt						
Copper						
Iron						
Lead						
Magnesium						
Manganese	1E-03		0.14		9E-03	
Mercury						
Nickel	2E-06		0.02			
Potassium						
Selenium	5E-08		0.005		1E-05	
Silver	2E-07		0.005		4E-05	
Sodium						
Thallium	4E-08		0.00009		5E-04	
Vanadium						
Zinc	2E-05		0.3		7E-05	
Cyanide	7E-07		0.02		4E-05	
Total HI and Car Risk					13	1E-03

ABBREVIATIONS

Car - carcinogenic
 CDI - chronic daily intake
 HI - hazard index
 mg/kg-day - milligrams per kilogram per day
 Nc - noncarcinogenic
 RfD - Reference Dose
 SVOCs - semivolatile organic compounds
 VOCs - volatile organic compounds

NOTES

1. CDIs for parameters which do not have toxicity or carcinogenic hazard data are not shown in Table.

target level of 1.0. The highest individual hazard quotients are for manganese (5), antimony (2) and arsenic (1). The highest organic hazard quotient is for 4,4'-DDT (0.8). The metals hazard quotients were based on 95th UCL concentrations, while the hazard quotient for 4,4'-DDT was calculated from the maximum detected concentration, 11 $\mu\text{g/L}$, which was present in well MW-01, located west of the pesticide pit.

The cancer risk for this scenario is 2×10^{-4} , which is above the EPA target range of 10^{-4} to 10^{-6} . The cancer risk drivers are arsenic (2×10^{-4}), beryllium (3×10^{-5}), 4,4'-DDT (3×10^{-5}), and 4,4'-DDD (2×10^{-5}). Cancer risks for bis (2-ethylhexyl)phthalate (1×10^{-6}) and 4,4'-DDE (2×10^{-6}) also exceeded 10^{-6} . Of these, only 4,4'-DDD and 4,4'-DDT were calculated using maximum concentrations. The maximum value of 4,4'-DDT was found in MW-01, while the maximum value of 4,4'-DDD was found in SW-02.

The HI for the dermal contact to groundwater scenario (Table 8-25) is 13, which exceeds the EPA target level of 1.0. The highest individual hazard quotient is for 4,4'-DDT (10), which accounts for most of the overall HI. The concentration of 4,4'-DDT used in the calculation was the 95th UCL.

The cancer risk for this scenario is 1×10^{-3} , which is above the EPA target range of 10^{-4} to 10^{-6} . The highest cancer risks are for 4,4'-DDT (1×10^{-3}), and 4,4'-DDD (3×10^{-4}), bis (2-ethylhexyl)phthalate (4×10^{-6}) and 4,4'-DDE (3×10^{-5}). Of these, only 4,4'-DDD and 4,4'-DDT were calculated using maximum concentrations. The maximum value of 4,4'-DDT was found in MW-01, while the maximum value of 4,4'-DDD was found in SW-02.

8.1.5.3.4 Risk Characterization for Lead Exposure

Lead is a COPC at many sites, however there are no published hazard evaluation criteria for this element (RfD, Reference Concentration, slope factor, or the inhalation unit risk). It is not a historical COPC at Site 2, but it was detected in groundwater at levels exceeding MCLs, which merits the inclusion of lead in the risk assessment. Since lead in soils was at or below background, the only real issue for lead is groundwater, even though the EPA model considers all media containing lead. Therefore, only the risks to future on-site residents need be considered. Lead risks are evaluated using EPA's Biokinetic Uptake Model. This model evaluates risks to children who are the most susceptible to health effects from lead. The Biokinetic Uptake Model estimates the blood lead level in children using a combination of site-specific and national default values for different media concentrations. Media considered include air, drinking water, soil, diet, paint, and dust. The model combines all the intakes to develop blood lead concentrations for children at different ages. These values can then be compared with national default values and with EPA guidance to evaluate site risks.

The following values were used in the model. A brief discussion of these values follows the table.

Media	National Default Value	Site-Specific Value
Air	0.20 $\mu\text{g}/\text{m}^3$	0.20 $\mu\text{g}/\text{m}^3$
Drinking Water	4.0 $\mu\text{g}/\text{L}$	35 $\mu\text{g}/\text{L}$
Soil	200 $\mu\text{g}/\text{g}$	16.8 $\mu\text{g}/\text{g}$
Diet	Default value, age dependent	Default value, age dependent
Paint	0.00 $\mu\text{g}/\text{day}$	0.00 $\mu\text{g}/\text{day}$
Dust	28% of soil value	28% of soil value

Most of the values used in the risk assessment are the same as the national default values. Site-specific data were available for soil and groundwater. Site groundwater concentrations were used as the drinking water input. For the other intakes it was assumed that the conditions at the site would be similar to those at most other sites. The paint uptake was left at 0.00 $\mu\text{g}/\text{day}$ because any homes at Site 2 would be new construction and would use lead-free paint.

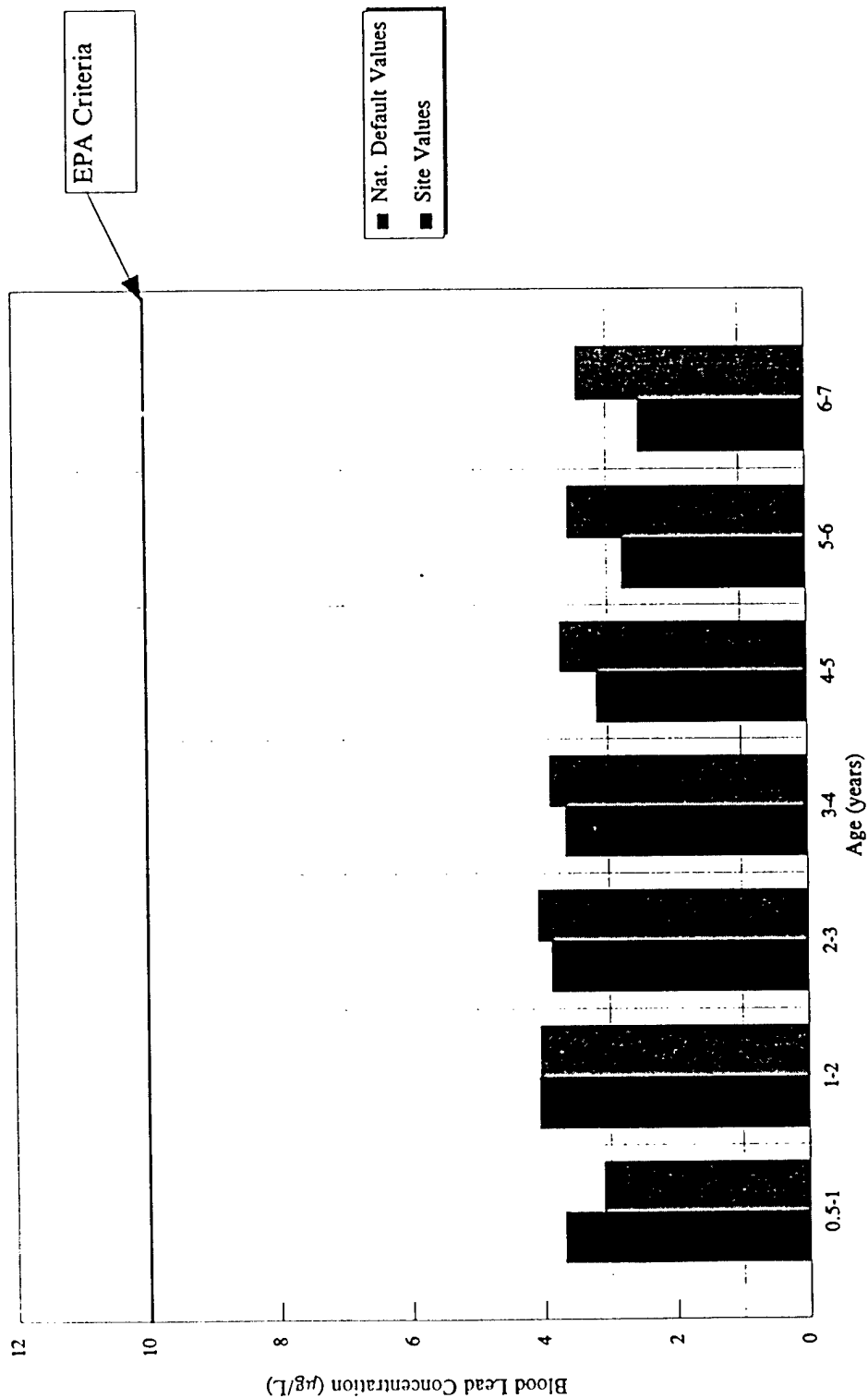
The results of the modelling runs are summarized in Figure 8-5. Full results are in Appendix M. The graph shows a comparison of the blood-lead levels calculated using site-specific data and the blood-lead levels calculated using the national default values. Both sets can be compared to EPA's health guideline of 10 micrograms per deciliter ($\mu\text{g}/\text{dL}$). As the figure shows, the site blood-lead levels slightly exceed the national default values for several of the age groups, but are well below the 10 $\mu\text{g}/\text{dL}$ standard, even using the maximum detected groundwater concentration of 35 $\mu\text{g}/\text{L}$. Only one groundwater sample (35 $\mu\text{g}/\text{L}$) exceeded the lead MCL of 15 $\mu\text{g}/\text{L}$. All the other groundwater samples had concentrations below 15 $\mu\text{g}/\text{L}$.

8.1.6 Human Health Risk Assessment Uncertainty Assessment

Uncertainty is inherent in many aspects of the risk assessment process. Each step in the process, from the initial sampling through the risk characterization adds some degree of uncertainty to the final risk estimates. This section will briefly discuss most of the uncertainty factors, and provide estimates of the potential errors for the Site 2 risk assessment.

8.1.6.1 Uncertainty in Data Collection and Evaluation

There are a number of uncertainty issues associated with the data collection and evaluation processes. One is the number and location of the samples. This project was an RI, and was planned to evaluate the nature and extent of contamination. Borings were placed in areas of suspected contamination, and samples were sent to the laboratory based upon screening results. As such, the soil sample results obtained can be classified as neither random nor systematic. Exposure point concentrations will be biased by applying statistical methods which assume the underlying contaminant distribution is either normal or lognormal. The statistical results at Stewart are driven by the 2 or 3 high results, not by a true distribution, and are not necessarily



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EVALUATION OF LEAD RISKS

NEWBURGH, NEW YORK

FIGURE: 8-5

reflective of the large number of non-detect samples. The exposure point concentrations derived from these results will tend to have a high bias and will generate risk values likely to be greater than the actual site risk. The collection of these non-random, non-systematic samples was necessary to meet the goals of the RI.

The locations of the monitoring wells for the RI also introduced uncertainty to the risk assessment. In accordance with ANGSIIP, monitoring wells were not installed in areas with obvious soil contamination (based on field screening results). Therefore, the monitoring well results may have a low bias. Another issue with monitoring wells is the location of the wells relative to Site 1, the former Base landfill. Several of the wells are downgradient of the landfill, and contaminants detected in these wells may be attributable to the landfill and not to Site 2.

Another important factor for groundwater is the lack of background data. As described above, the groundwater gradients determined from the wells installed for the RI were different from the historical gradients, and indicated near-radial flow from Site 2. Therefore, wells believed to be background based on historical flow patterns were determined to be downgradient of the site. Without background data, it was not possible to evaluate the metals concentrations detected in order to determine if the metals were indicative of site contamination, or are reflective of background conditions. In order to be conservative, all metals were retained in the risk assessment. As metals were a major component of the calculated risk, it is evident that the lack of metals background data is biasing the results of the risk assessment to the high side.

Uncertainty is also introduced by using the 95th UCL to estimate risks. This calculation assumes that the COPC is present in all the samples of a given media, and the concentration is assumed to be one-half the detection limit in all samples reported as non-detects. In reality, for COPCs detected in only a few samples, the COPC is likely not present in all of the samples. Using this approach to calculate the exposure point concentration will cause an overestimation of site risks, and is a more conservative approach.

Uncertainty is also introduced through the use of qualified data. As a result of the data validation process, all data was indicated as acceptable, or flagged as "U," indicating non-detect, "J," indicating estimated value, or "R," indicating that the datum was rejected. All unflagged and J-flagged data were used as is. All U-flagged data were used at one-half the reported value. All R-flagged data was omitted from the risk assessment. This process can introduce uncertainty in several ways. The use of estimated data can result in either under or overestimation of site risks. The use of one-half the detection limit may also under or overestimate risks, though overestimation of risks may be more likely. The presence of rejected data is more difficult to evaluate. At Site 2, for a few analytes, the number of data points was reduced to a point where the statistical methods are more prone to errors. This was evident in only a few cases, most notably for 4,4'-DDT in sediment. This likely resulted in an overestimation of risks.

The presence of Tentatively Identified Compounds (TICs) is an issue which may result in an underestimation of risks. When only a small number of TICs are present at a site, as was the case at Site 2, TICs are not considered in the quantitative risk assessment. These COPCs,

however, do pose a risk, and not including them in the risk assessment will result in an underestimation of site risks. At Site 2, few TICs were reported, and the exclusion of TICs from the risk assessment does not affect the overall results.

8.1.6.2 Uncertainty in Exposure Assessment

A number of uncertainties are inherent in evaluating exposures and predicting future land use. A large part of the risk assessment is the estimation of risks that are conditional upon the existence of the exposure conditions analyzed. If the exposure does not occur, no risks are present. The assessment does not consider the probability of these exposures actually occurring. This is especially evident when considering future exposures. The future construction worker scenario assumes that construction will take place at the site over a large number of years, an extremely unlikely event given the small size of the site and the current land uses. The use of this conservative assumption will likely lead to an overestimation of site risks.

The future residential assumptions also add a high bias to the risk results. The future residential scenario assumes that residences will be built close to the site and a drinking water well will be drilled into the shallow bedrock within the area of contamination. The scenario also assumes no attenuation of contamination over time. This is highly unlikely for a number of reasons. First, the site is part of an active Base, which will likely remain active for the foreseeable future. Site 1, located within 40 to 50 feet of Site 2, is planned for construction of a cap in the next two years. Along with this landfill cap, fencing and other restrictions on land use will be put in place. Also, the shallow bedrock is not a major source of water, and would not likely be tapped by an on-site well, especially since city water is supplied to the Base. Any residential use of the site, though unlikely, would be many years into the future, and natural attenuation may have slightly reduced the site contamination. Again, these are all highly conservative assumptions which will likely result in an overestimation of site risks.

For residential land use scenarios, all soil exposures were assumed to have an exposure frequency of 350 days per year. This will result in an overestimation of site risks, as it does not account for snow covering, or other inclement weather which would limit exposures. As described above, the use of these conservative assumptions will generate a risk estimate greater than the actual site risk.

8.1.6.3 Uncertainty in Toxicity Assessment

It is important to note that pesticides, the primary COPCs at Site 2, all had toxicity values. This decreases the uncertainty in the risk evaluation because it allows for full evaluation of the risks from the pesticides.

A number of the COPCs at Site 2, however, had no published reference doses or slope factors. These were:

VOCs

- chloromethane
- 1,1-dichloroethane
- cis-1,2-dichloroethene
- 2-hexanone
- 4-methyl-2-pentanone
- trichloroethene
- vinyl chloride

SVOCs

- 2-methylnaphthalene
- benzo(a)anthracene
- benzo(b)fluoranthene
- benzo(k)fluoranthene
- benzo(g,h,i)perylene
- carbazole
- chrysene
- dibenz(a,h)anthracene
- di-n-octylphthalate
- indeno(1,2,3-cd)pyrene
- naphthalene
- phenanthrene
- dibenzofuran

Inorganics

- aluminum
- calcium
- cobalt
- copper
- iron
- lead
- magnesium
- potassium
- sodium
- vanadium

Of these, a number have toxicity information such as weight of evidence classification which indicates that these have a strong potential for adverse health effects. The lack of toxicity values for these chemicals leads to an underestimation of site risks, but this is likely not significant as these chemicals are not the primary COPCs.

Several of these compounds, such as chrysene, did not have toxicity values, but as described previously, were included in the risk assessment through the use of TEFs. Because the TEFs are estimates, the use of the TEFs adds a measure of uncertainty to the final result, but lowers the degree of underestimation since these COPCs are at least evaluated. TEFs are conservative estimates, so the use of TEFs will likely result in an overestimation of site risks.

Uncertainty is also inherent in the toxicity values themselves. Many of the studies used to develop these numbers were conducted on animals, with the results extrapolated to humans. In addition, many of the studies evaluated subchronic exposures, with the toxicity values extrapolated to chronic effects. Because the resulting toxicity values are often based on 95th percentile confidence intervals, chemical-specific risks may be overestimated.

Toxicity information was not available for dermal exposure and several assumptions were made which increase the uncertainty of the results. For dermal contact to groundwater, oral toxicity

values were used without adjustment to calculate risks from dermal exposure because EPA has not derived toxicity values for this type of exposure. There have not been many studies evaluating this type of exposure. This assumes that in the study used to determine the RfD, 100% of the chemical administered was adsorbed by the test subject. However, this is also a very conservative assumption. It is likely that for most, if not all COPCs at Site 2, the absorbed dose from dermal exposures would be less than the dose from ingestion. The digestive tract functions to absorb materials from food, while the skin functions as a protective barrier to prevent absorption. Therefore, estimating dermal toxicity values from oral toxicity values by assuming a ratio between the administered dose (oral exposure) and the absorbed dose (dermal exposure) of 100% will likely overestimate the risk.

8.1.6.4 Uncertainty in Risk Characterization

A major cause of uncertainty in the risk characterization is the assumption that the effects of multiple exposures are additive. This assumption ignores synergisms and antagonisms between the various chemicals, and assumes a similarity in mechanisms of action and metabolism, assumptions which tend to overestimate risk. In addition, risks summed for chemicals having various weight-of-evidence classifications as well as different target organisms also tends to overestimate risk.

There is also uncertainty associated with the lack of background data. Because a large portion of the risk from groundwater is due to metals, which are not historical contaminants of concern at Site 2, the lack of groundwater background data is likely causing risks to be overestimated. Several, if not all, of the metals contributing to the site risk are probably reflective of background conditions. This argument can be supported by examining the metals data from soils. No metals were present in soils (the source area) at levels exceeding background, so there is no obvious source of metals contamination to groundwater.

Another factor is the inclusion of chemicals which result in unacceptable risk at their quantitation limits. A number of these chemicals are listed in RAGS, including antimony, arsenic, and benzo(a)pyrene, all of which are present at Site 2. Antimony and arsenic will yield unacceptable HQs at their detection limits in groundwater. Even one detection of these chemicals at a site could result in unacceptable risk levels, indicating that the presence of these chemicals at Site 2 may result in an overestimation of site risks.

8.1.7 Human Health Risk Assessment Conclusions

A quantitative human health risk assessment was conducted for Site 2. The conclusions are as follows:

- The risks for all current site receptors are within or below the EPA targets.
- The risks for all future receptors, with the exception of future residents, are within or below the EPA targets.

- The risks to future receptors exceed EPA risk targets for only one environmental medium, groundwater. Exposure scenarios involving either ingestion of or dermal contact to groundwater produced carcinogenic and noncarcinogenic risks that marginally exceeded EPA risk targets. However, extremely conservative exposure assumptions were used in these risk calculations. Therefore, it is likely that the risks are highly overestimated and that actual site risks would be much lower.

8.2 Ecological Risk Assessment

An ecological risk assessment was performed to evaluate potential risks to habitats and ecological receptors within and adjacent to Site 2. This ecological risk assessment describes existing habitats and ecological receptor species expected to inhabit the vicinity of the site and evaluates potential risks associated with exposure of these biota to detected sediment constituents. The ecological risk assessment is largely a screening-level analysis of potential environmental risk. It should be noted that while the following ecological risk assessment is presented in a format following an EPA approach, NYSDEC Step I Fish and Wildlife Impact Analysis requirements have been included in the following sections.

8.2.1 Introduction

This ecological characterization describes the existing habitats and ecological receptor species that have been noted or are expected to be present in the vicinity of Site 2 at Stewart ANG Base. The discussion of habitats and receptor species is based on existing information obtained from various state agencies and a site visit conducted by an ecologist.

8.2.2 Habitat and Receptor Species Characterization

8.2.2.1 Ecological Setting

The site is located within the Hudson Valley (Central Hudson) ecozone (Reschke, 1990). A topographical map of the site depicting important ecological resource areas within a two-mile radius of the site is presented in Figure 8-6. No NYSDEC Significant Habitats (as defined by the Natural Heritage Program) or habitats supporting endangered, threatened, or rare species are present within two miles of the site (Appendix N).

Several significant water bodies are located within two miles of the site. Lake Washington represents the nearest significant aquatic habitat in proximity to the site and is located approximately 2,000 feet southeast of Site 2. Brookside Pond and Silver Stream Reservoir are located approximately 1.5 miles northeast and south of the site, respectively. Several named streams (Quassaic Creek and Silver Stream) and numerous unnamed streams are also present within two miles of the site (Figure 8-6). No wild, scenic and recreational rivers are present in the vicinity of the site (Appendix N).



STEWART AIR NATIONAL GUARD BASE
TOPOGRAPHIC MAP
FISH AND WILDLIFE RESOURCES
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FIGURE: 8-6

In addition to the aquatic resources discussed above, six NYSDEC-regulated wetlands are located within a two-mile radius of the site. Wetlands CO-3 and CO-19 are each located approximately one mile southwest and southeast of the site, respectively. Other state-regulated wetlands present within two miles of the site include CO-6 (1.3 miles south of the site), CO-2 (1.5 miles west of the site), NB-27 (1.5 miles northwest of the site), and NB-29 (1.4 miles northeast of the site).

8.2.2.2 Drainage Characteristics

Surface water runoff from the site flows to the east within several small intermittent channels located downslope of Site 2. These channels appear to contain surface water flows only in response to periods of precipitation. The channels discharge runoff water into a large forested and wet meadow wetland area located at the base of the slope. Prior to the construction of Interstate Route 87, it appears that surface water from the site flowed into the wetlands at the base of the slope and then southeast in Lake Washington. Current surface water flows downgradient from this wetland are depicted in Figure 8-7.

Surface waters flow to the north from the wetland located at the base of the slope and then east via a culvert under Interstate Route 87 (New York State Thruway). Surface waters then continue within a small unnamed stream which flows northeast for approximately 7,000 feet into Brookside Pond. This pond forms a portion of NYSDEC-regulated wetland NB-29. Surface waters from Brookside Pond enter Quassaic Creek and flow southeast for approximately 3,000 feet into Harrison Pond (an impounded portion of Quassaic Creek). Surface water flows east after exiting Harrison Pond within Quassaic Creek for approximately 4,000 feet where it enters Muchattoes Lake (another impounded portion of Quassaic Creek). Surface water flows continue to the east within Quassaic Creek and discharge into the Hudson River approximately 7,200 feet downstream from Muchattoes Lake. The lower portion of Quassaic Creek (downstream of Harrison Pond) is classified by NYSDEC as a Class C waterway. The portion of Quassaic Creek located upstream of Harrison Pond to Brookside Pond represents a Class D waterway. Class C and D waters are best suited for fishing. Class C waters are suitable for fish propagation and survival while Class D waters are suitable for fish survival but natural conditions do not support fish propagation.

8.2.2.3 Habitat Cover Types

Four wetland cover types (Cowardin et al., 1989) were identified within one-half mile of the study area: palustrine emergent wetlands (wet meadow), palustrine forested wetlands, palustrine open water (pond), and lacustrine open water (lake). Three upland cover types were also identified in the study area: grasslands, old field habitat (deciduous shrubland), and deciduous forest. Figure 8-8 depicts the locations of habitat cover types present within one-half mile of the site. Brief descriptions of each identified cover type are presented in the following sections. The habitats noted within one-half mile of the site are typical for this area of New York and do not represent unusual natural communities.



STEWART AIR NATIONAL GUARD BASE

DRAINAGE MAP

NEWBURGH, NEW YORK

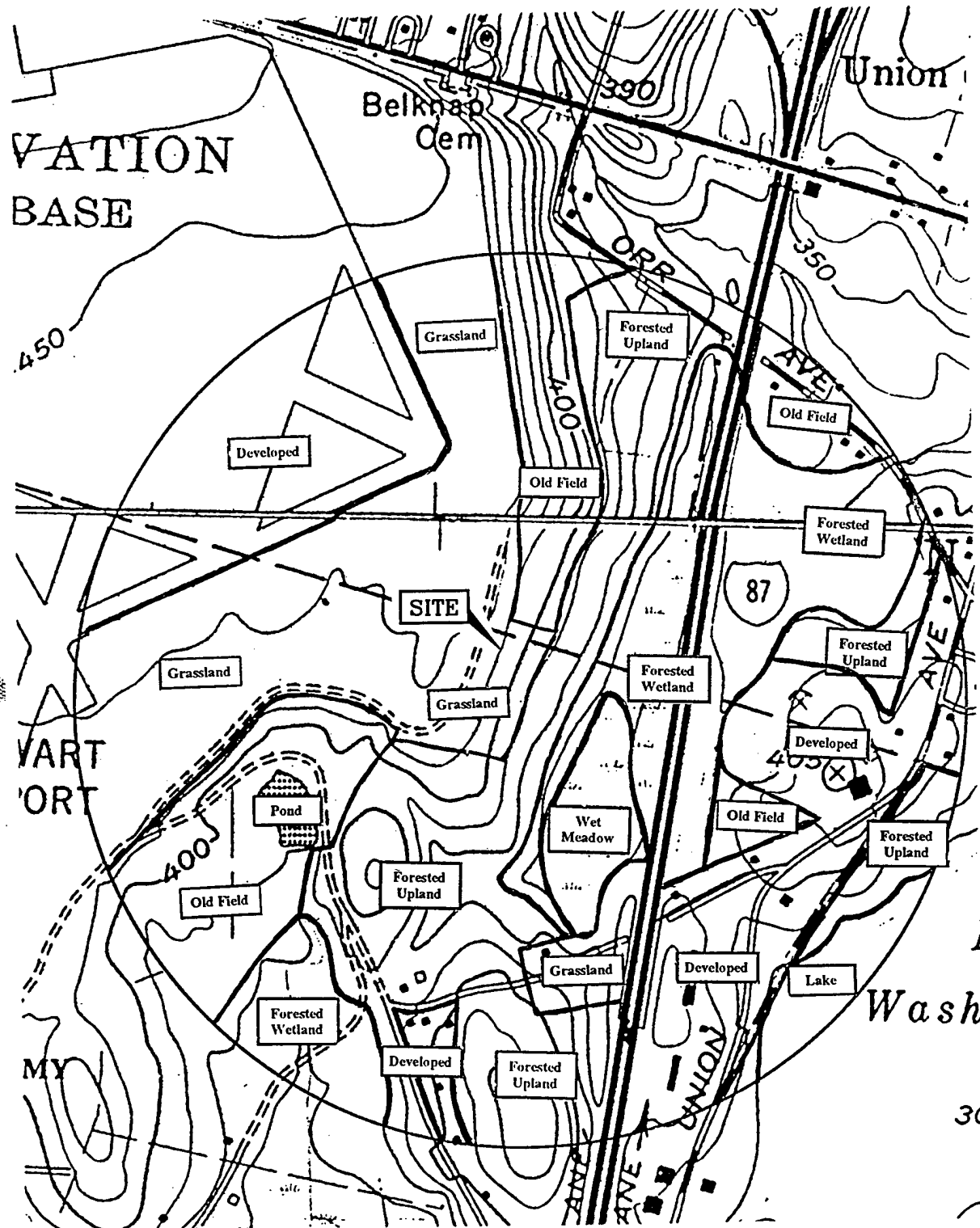


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FIGURE: 8-7

Last Revision Date: 3/25/97

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COVERTYPE MAP

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FIGURE: 8-8

Palustrine Emergent Wetlands (Wet Meadow)

This cover type is present within one area located at the base of the slope downgradient from the site. This wetland likely contains shallow standing and/or flowing surface water during wetter portions of the year but may be saturated to the surface during the remaining portions of the year. Vegetation noted within this wetland cover type includes various herbaceous species including sensitive fern (*Onoclea sensibilis*), common reed (*Phragmites australicus*), hydrophilic grasses (*Gramineae* spp.), and sedges (*Carex* spp.).

Palustrine Forested Wetlands

Forested wetlands are present downgradient of the site within a fairly large area bisected by Interstate 87 and within another area located south of the site. Soils within these forested wetlands consist predominately of Alden soils which are very poorly drained (water table is at or near the surface for most of the year). The overstory trees are composed primarily of red maple (*Acer rubrum*), american elm (*Ulmus americana*) and swamp white oak (*Quercus bicolor*). Common shrub vegetation consists of arrow-wood (*Viburnum dentatum*) and spicebush (*Lindera benzoin*) while herbaceous vegetation is comprised primarily of sensitive fern and skunk cabbage (*Symplocarpus foetidus*). Poison ivy (*Toxicodendrons radicans*) is also common within the forested wetlands.

Palustrine/Lacustrine Open Water (Pond/Lake)

A small man-made recreational pond, located on Base, is present approximately 1,500 feet southwest of Site 2. Lake Washington is present nearly one-half mile southeast of Site 2. Site 2 is not present within the watershed area of these aquatic habitats. The water quality classification for Lake Washington is listed by NYSDEC as Class A. This surface water classification designates best usages as water supply (drinking), primary and secondary contact recreation, and fishing. These waters are suitable for fish propagation and survival.

Grassland

This cover type is found primarily at disturbed areas located within the vicinity of the site and on the site itself. Large areas of this cover type are present west of Site 2 and are associated with the Stewart International Airport. Another area is located southeast of the site and is attributable to a capped municipal landfill. This habitat consists mostly of various grasses such as bluestem (*Andropogon* sp.) and forbs such as plantains (*Plantago* spp.), dandelion (*Taraxacum officinale*) and clover (*Trifolium* spp.). These areas are periodically maintained by mowing to limit the height of the herbaceous vegetation and prevent growth of woody vegetation.

Old Field (Deciduous Shrubland)

The old field or deciduous shrubland habitat in the vicinity of the site includes large areas located north and southwest of Site 2 and several smaller areas located east of Interstate 87 (Figure 8-8). These areas, formerly grassland habitats, are now undergoing natural succession to forested communities. Dominant shrub species within this habitat include red cedar (*Juniperus virginiana*), common buckthorn (*Rhamnus catharticus*), and staghorn sumac (*Rhus typhina*). The herbaceous layer consisted of various grasses, milkweed (*Asclepias* sp.) and goldenrods (*Solidago* spp.).

Deciduous Forest Upland

This cover type is primarily present immediately south and east of the site. The dominant overstory tree species include red maple, black cherry (*Prunus serotina*), and red oak (*Quercus rubra*). Common understory vegetation includes black haw (*Viburnum prunifolium*), poison ivy, grape (*Vitis* sp.), garlic-mustard (*Alliaria petiolata*), and wild onion (*Allium vineale*). Areas of this cover type generally consisted of relatively young forested stands as large mature trees were not noted.

8.2.2.4 Ecological Receptor Species

A potential wildlife species list was prepared based upon the geographical location of the site, wetland/upland cover types known to be present, and habitat conditions present within the wetland and upland cover types. This species list is provided as Table 8-26 and represents potential amphibians, birds, mammals, reptiles, and fish which may inhabit each of the cover types present within the vicinity of the site during the breeding season (spring and summer). Additional avian species would also be expected to use the identified habitat cover types overwinter or during periods of spring and fall migration. However, these species would likely have less exposure to site-related constituents than species using the adjacent habitats year-round or during the breeding period.

8.2.3 Exposure Assessment

Surficial sediment samples were analyzed for use in the ecological risk assessment. It was assumed that concentrations detected within these sediment samples are equivalent to the exposure point concentrations that would contact potential benthic receptors. For purposes of this risk assessment, these sediments were treated as having been collected from a true aquatic habitat. As such, these sediments would have the potential to affect benthic organisms, aquatic vegetation and other segments of the food web. This is a conservative approach because the drainage pathway is only periodically inundated with storm drainage. Except for one small temporary pool, the drainage pathway does not have standing water and is only capable of providing habitat for aquatic organisms on a short-term basis.

Sediment samples were collected within the drainage path leading from Site 2. Sample SS-01 was taken upgradient from the entry point of drainage from Site 2 and provides background concentrations. SS-02 was taken from the drainage ditch downstream of the entry point in order to identify possible impact from burial pit drainage. SS-03 was collected upgradient of the culvert passing underneath the patrol road, and also provides background concentrations. SS-04 was taken from the outwash area downgradient of the culvert. SS-05 was taken from within the area of the temporary pool of standing water. SS-06 was taken near the pool in the area where a sample taken during the 1989 SI yielded the highest concentrations of pesticides. SS-07 was taken further down the drainage path.

TABLE 8-26
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE					
						A	B	C	D	E	F
Amphibians	Eastern American Toad	<i>Bufo a. americanus</i>	I	Ground Ambusher	Water	X	X	X	X	X	X
	Gray Treefrog	<i>Hyla versicolor</i>	I	Bark Ambusher	Water		X	X	X	X	X
Hylidae	Northern Spring Peeper	<i>Pseudacris c. crucifer</i>	I	Riparian Ambusher	Water		X	X	X	X	X
	Redback Salamander	<i>Plethodon c. cinereus</i>	I	Ground Gleaner	Terrestrial Subsurface		X	X	X		
Plethodontidae	Bullfrog	<i>Rana catesbeiana</i>	C	Water Ambusher	Water						X
	Green Frog	<i>Rana clamitans melanota</i>	I	Riparian Ambusher	Water				X	X	X
Ranidae	Northern Leopard Frog	<i>Rana pipiens</i>	I	Riparian Ambusher	Water				X	X	X
	Pickrel Frog	<i>Rana palustris</i>	I	Riparian Ambusher	Water				X	X	X
Salamandridae	Wood Frog	<i>Rana sylvatica</i>	I	Ground Ambusher	Water		X	X	X	X	X
	Red-spotted Newt	<i>Notophthalmus viridescens</i>	I	Water Gleaner	Water		X	X	X	X	X
Birds											
Accipitridae	Broad-winged Hawk	<i>Buteo platypterus</i>	C	Ground Pouncer	Tree-Branch			X	X		
	Red-tailed Hawk	<i>Buteo jamaicensis</i>	C	Ground Pouncer	Tree-Branch	X	X	X	X		
Alaudidae	Horned Lark	<i>Eremophila alpestris</i>	O	Ground Gleaner	Ground-Herb	X					X
	Belted Kingfisher	<i>Ceryle alcyon</i>	P	Water Plunger	Riparian Subsurface						X
Alcedinidae	American Black Duck	<i>Anas rubripes</i>	O	Water Forager	Riparian Ground						X
	Blue-winged Teal	<i>Anas discors</i>	O	Water Forager	Riparian Ground						X
Anatidae	Canada Goose	<i>Branta canadensis</i>	H	Ground Grazer	Riparian Ground	X					X
	Common Merganser	<i>Mergus merganser</i>	P	Water Diver	Riparian Tree Cavity						X
Green-winged Teal		<i>Anas crecca</i>	H	Water Grazer	Riparian Ground						X
	Hooded Merganser	<i>Lophodytes cucullatus</i>	P	Water Diver	Riparian Tree Cavity						X
Mallard		<i>Anas platyrhynchos</i>	G	Water Forager	Riparian Ground						X
	Mute Swan	<i>Cygnus olor</i>	H	Water Grazer	Riparian Ground						X
Wood Duck		<i>Aix sponsa</i>	G	Water Forager	Riparian Tree Cavity				X		X
	Chimney Swift	<i>Chaetura pelagica</i>	I	Air Screener	Buildings	X	X				
Apodidae	Great Blue Heron	<i>Ardea herodias</i>	C	Water Ambusher	Riparian Twig-Branch					X	X
Ardeidae	Green-backed Heron	<i>Butorides striatus</i>	C	Water Ambusher	Riparian Shrub					X	X
	Cedar Waxwing	<i>Bombicilla cedrorum</i>	F	Upper Canopy Gleaner	Tree-Twig		X	X	X		
Bombycillidae	Whip-poor-will	<i>Caprimulgus vociferus</i>	I	Air Screener	Ground-Herb		X	X			
Caprimulgidae	Brown Creeper	<i>Certhia americana</i>	I	Bark Gleaner	Tree Cavity-Crevices			X	X		

TABLE 8-26 (cont.)
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE						
						A	B	C	D	E	F	
Charadriidae	Killdeer	<i>Charadrius vociferus</i>	I	Ground Gleaner	Ground-Herb	X					X	
	Mourning Dove	<i>Zenaidra macroura</i>	G	Ground Gleaner	Tree-Branch	X	X	X	X			
	Rock Dove	<i>Columba livia</i>	O	Ground Gleaner	Buildings	X						
	American Crow	<i>Corvus brachyrhynchos</i>	O	Ground Gleaner	Tree-Branch	X	X	X	X			
Corvidae	Blue Jay	<i>Cyanocitta cristata</i>	O	Ground Gleaner	Tree-Branch	X	X	X	X			
	Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	I	Lower Canopy Gleaner	Tree-Branch	X	X	X				
	Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	I	Lower Canopy Gleaner	Tree Cavity-Crevise	X						
	American Kestrel	<i>Falco sparverius</i>	C	Ground Pouncer	Shrub	X	X	X	X			
Falconidae	American Goldfinch	<i>Carduelis tristis</i>	O	Ground Gleaner	Shrub	X						
Fringillidae	Chipping Sparrow	<i>Spizella passerina</i>	O	Ground Gleaner	Ground-Herb	X	X	X	X			
	Dark-eyed Junco	<i>Junco hyemalis</i>	G	Ground Gleaner	Ground-Herb	X	X	X	X			
	Field Sparrow	<i>Spizella pusilla</i>	O	Ground Gleaner	Ground-Herb	X	X	X	X			
	Indigo Bunting	<i>Passerina cyanea</i>	I	Lower Canopy Gleaner	Shrub	X	X	X	X			
	Northern Cardinal	<i>Cardinalis cardinalis</i>	O	Ground Gleaner	Tree-Twig	X						
	Rose-breasted Grosbeak	<i>Phoebastria ludovicianus</i>	O	Lower Canopy Gleaner	Ground-Herb	X	X	X	X			
	Savannah Sparrow	<i>Passerculus sandwichensis</i>	O	Ground Gleaner	Ground-Herb	X	X	X	X			
	Song Sparrow	<i>Melospiza melodia</i>	O	Ground Gleaner	Riparian Ground	X						
	Swamp Sparrow	<i>Melospiza georgiana</i>	I	Ground Gleaner	Terrestrial Subsurface	X	X	X	X			
	Bank Swallow	<i>Riparia riparia</i>	I	Air Screener	Buildings	X						
	Barn Swallow	<i>Hirundo rustica</i>	I	Air Screener	Buildings	X						
	Hirundinidae	Cliff Swallow	<i>Hirundo pyrrhonota</i>	I	Air Screener	Buildings	X					
Purple Martin		<i>Progne subis</i>	I	Air Screener	Buildings	X						
Tree Swallow		<i>Tachycineta bicolor</i>	I	Air Screener	Tree Cavity-Crevise	X	X	X	X			
Baltimore Oriole		<i>Icterus galbula</i>	O	Upper Canopy Gleaner	Tree-Twig	X	X	X	X			
Icteridae	Brown-headed Cowbird	<i>Molothrus ater</i>	O	Ground Gleaner	Nest Parasite	X	X	X	X			
	Common Grackle	<i>Quiscalus quiscula</i>	O	Ground Gleaner	Tree-Branch	X	X	X	X			
	Eastern Meadowlark	<i>Sturnella magna</i>	I	Ground Gleaner	Ground-Herb	X	X	X	X			
	Red-winged Blackbird	<i>Agelaius phoeniceus</i>	O	Ground Gleaner	Shrub	X	X	X	X			
Laridae	Herring Gull	<i>Larus argentatus</i>	C	Coastal Scavenger	Beach-Rock-Dune	X						
Meleagrididae	Wild Turkey	<i>Meleagris gallopavo</i>	O	Ground Gleaner	Ground-Herb	X	X	X	X			
	Brown Thrasher	<i>Toxostoma rufum</i>	O	Ground Gleaner	Shrub	X						

TABLE 8-26 (cont.)
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE					
						A	B	C	D	E	F
Paridae	Gray Catbird	<i>Dumetella carolinensis</i>	O	Ground Gleaner	Shrub	X			X		
	Northern Mockingbird	<i>Mimus polyglottos</i>	O	Ground Gleaner	Shrub	X					
	Black-capped Chickadee	<i>Parus atricapillus</i>	I	Lower Canopy Gleaner	Tree Cavity-Crevise		X	X	X		
Parulidae	Tufted Titmouse	<i>Parus bicolor</i>	I	Lower Canopy Gleaner	Tree Cavity-Crevise			X	X		
	American Redstart	<i>Setophaga ruticilla</i>	I	Lower Canopy Gleaner	Tree-Twig			X	X		
Parulidae	Black-and-White Warbler	<i>Mniotilta varia</i>	I	Bark Gleaner	Ground-Herb			X	X		
	Blue-winged Warbler	<i>Vermivora pinus</i>	I	Lower Canopy Gleaner	Ground-Herb		X				
Phasianidae	Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	I	Lower Canopy Gleaner	Shrub		X				
	Common Yellowthroat	<i>Geothlypis trichas</i>	I	Lower Canopy Gleaner	Ground-Herb		X		X	X	
Picidae	Ovenbird	<i>Seiurus aurocapillus</i>	I	Ground Gleaner	Ground-Herb			X	X		
	Prairie Warbler	<i>Dendroica discolor</i>	I	Lower Canopy Gleaner	Shrub		X				
Picidae	Yellow Warbler	<i>Dendroica petechia</i>	I	Lower Canopy Gleaner	Shrub		X				
	Ring-necked Pheasant	<i>Phasianus colchicus</i>	O	Ground Gleaner	Ground-Herb	X					
Picidae	Downy Woodpecker	<i>Picoides pubescens</i>	I	Bark Gleaner	Tree Cavity-Crevise			X	X		
	Hairy Woodpecker	<i>Picoides villosus</i>	I	Bark Gleaner	Tree Cavity-Crevise	X		X	X		
Ploceidae	Northern Flicker	<i>Colaptes auratus</i>	I	Ground Gleaner	Tree Cavity-Crevise	X		X	X		
	Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	O	Bark Excavator	Buildings	X					
Scolopacidae	House Sparrow	<i>Passer domesticus</i>	G	Ground Gleaner	Ground-Herb		X		X	X	
	American Woodcock	<i>Scolopax minor</i>	I	Ground Prober	Ground-Herb						X
Sittidae	Spotted Sandpiper	<i>Actitis macularia</i>	O	Riparian Gleaner	Ground-Herb						
	White-breasted Nuthatch	<i>Sitta carolinensis</i>	I	Bark Gleaner	Tree Cavity-Crevise			X	X		
Strigidae	Eastern Screech-Owl	<i>Otus asio</i>	C	Ground Pouncer	Tree Cavity-Crevise		X	X	X	X	
	Great Horned Owl	<i>Bubo virginianus</i>	C	Ground Pouncer	Tree-Branch	X	X	X	X	X	
Sturnidae	European Starling	<i>Sturnus vulgaris</i>	C	Ground Gleaner	Buildings	X	X	X	X	X	
	Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	I	Upper Canopy Gleaner	Tree-Branch		X	X	X		
Sylviidae	Ruffed Grouse	<i>Bonasa umbellus</i>	O	Ground Gleaner	Ground-Herb		X	X	X		
	Scarlet Tanager	<i>Piranga olivacea</i>	I	Upper Canopy Gleaner	Tree-Twig			X	X		
Troglodytidae	Ruby-throated Hummingbird	<i>Archilochus colubris</i>	O	Floral Hover-Gleaner	Tree-Branch		X	X	X		
	House Wren	<i>Troglodytes aedon</i>	I	Lower Canopy Gleaner	Tree Cavity-Crevise		X	X	X		
Turdidae	American Robin	<i>Turdus migratorius</i>	O	Ground Gleaner	Tree-Branch	X	X	X	X		
	Veery	<i>Catharus fuscescens</i>	O	Ground Gleaner	Ground-Herb				X		

TABLE 8-26 (cont.)
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE						
						A	B	C	D	E	F	
Tyrannidae	Wood Thrush	<i>Hylocichla mustelina</i>	O	Ground Gleaner	Tree-Branch	X			X			
	Eastern Kingbird	<i>Tyrannus tyrannus</i>	I	Air Sallier	Tree-Twig	X	X				X	
	Eastern Phoebe	<i>Sayornis phoebe</i>	I	Air Sallier	Buildings		X		X			
	Eastern Wood-Pewee	<i>Contopus virens</i>	I	Air Sallier	Tree Branch			X	X			
	Great Crested Flycatcher	<i>Myiarchus crinitus</i>	I	Air Sallier	Tree Cavity-Crevise			X	X			
Vireonidae	Red-eyed Vireo	<i>Vireo olivaceus</i>	I	Upper Canopy Gleaner	Tree-Twig			X	X			
Fish	White Sucker	<i>Catostomus commersoni</i>	I	Water Bottom	Water Substrate						X	
	Black Crappie	<i>Pomoxis nigromaculatus</i>	I	Water	Water Substrate						X	
	Bluegill	<i>Lepomis macrochirus</i>	I	Water	Water Substrate						X	
	Largemouth Bass	<i>Micropterus salmoides</i>	C	Water	Water Substrate						X	
	Pumpkinseed	<i>Lepomis gibbosus</i>	I	Water	Water Substrate						X	
Cyprinidae	Redbreast Sunfish	<i>Lepomis auritus</i>	I	Water	Water Substrate						X	
	Rock Bass	<i>Ambloplites rupestris</i>	I	Water	Water Substrate						X	
	Smallmouth Bass	<i>Micropterus dolomieu</i>	I	Water	Water Substrate						X	
	Bluntnose Minnow	<i>Pimephales notatus</i>	O	Water	Water Substrate						X	
	Bridle Shiner	<i>Notropis bifrenatus</i>	O	Water	Water Vegetation						X	
	Carp	<i>Cyprinus carpio</i>	O	Water Bottom	Water Vegetation						X	
	Common Shiner	<i>Notropis cornutus</i>	I	Water	Water Substrate						X	
	Creek Chub	<i>Semotilus atromaculatus</i>	O	Water	Water Substrate						X	
	Fathead Minnow	<i>Pimephales promelas</i>	O	Water	Water Substrate						X	
	Golden Shiner	<i>Notemigonus crysoleucas</i>	O	Water	Water Vegetation						X	
	Goldfish	<i>Carassius auratus</i>	O	Water Bottom	Water Vegetation						X	
	Spottail Shiner	<i>Notropis hudsonius</i>	I	Water	Water Substrate						X	
	Chain Pickerel	<i>Esox niger</i>	P	Water	Water						X	
	Grass Pickerel	<i>Esox americanus</i>	P	Water	Water						X	
	Brown Bullhead	<i>Ictalurus nebulosus</i>	O	Water Bottom	Water Substrate						X	
Percichthyidae	Yellow Bullhead	<i>Ictalurus natalis</i>	O	Water Bottom	Water Substrate						X	
	White Perch	<i>Morone americana</i>	I	Water	Water Substrate						X	
Percidae	Yellow Perch	<i>Perca flavescens</i>	I	Water	Water						X	

TABLE 8-26 (cont.)
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE					
						A	B	C	D	E	F
Mammals Canidae	Coyote	<i>Canis latrans</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
	Gray Fox	<i>Urocyon cinereoargenteus</i>	O	Ground Forager	Ground-Herb	X	X	X	X	X	
	Red Fox	<i>Vulpes vulpes</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
Castoridae	Beaver	<i>Castor canadensis</i>	H	Water Grazer	Riparian Subsurface						X
	White-tailed Deer	<i>Odocoileus virginianus</i>	H	Ground Grazer	Ground-Herb	X	X	X	X	X	
Cervidae	Deer Mouse	<i>Peromyscus maniculatus</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
	Meadow Vole	<i>Microtus pennsylvanicus</i>	H	Ground Grazer	Terrestrial Subsurface	X	X			X	
Cricetidae	Muskrat	<i>Ondatra zibethicus</i>	H	Water Grazer	Riparian Subsurface					X	X
	S. Red-backed Vole	<i>Clethrionomys gapperi</i>	H	Ground Grazer	Terrestrial Subsurface		X	X	X		
Didelphidae	White-footed Mouse	<i>Peromyscus leucopus</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
	Virginia Opossum	<i>Didelphis virginiana</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
Leporidae	Eastern Cottontail	<i>Sylvilagus floridanus</i>	H	Ground Grazer	Tree Cavity-Crevices	X	X	X	X	X	
	House Mouse	<i>Mus musculus</i>	O	Ground Forager	Ground-Herb	X					
Muridae	Norway Rat	<i>Rattus norvegicus</i>	O	Ground Forager	Buildings	X					
	Ermine	<i>Mustela erminea</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
Mustelidae	Long-tailed Weasel	<i>Mustela frenata</i>	C	Ground Pursuer	Ground-Herb	X	X	X	X	X	
	Mink	<i>Mustela vison</i>	C	Ground Pursuer	Terrestrial Subsurface	X	X	X	X	X	
Procyonidae	River Otter	<i>Lutra canadensis</i>	P	Water Diver	Riparian Subsurface						X
	Striped Skunk	<i>Mephitis mephitis</i>	P	Water Diver	Riparian Subsurface						X
Sciuridae	Raccoon	<i>Procyon lotor</i>	O	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
	Eastern Chipmunk	<i>Tamias striatus</i>	O	Ground Forager	Tree Cavity-Crevices	X	X	X	X	X	
Sciuridae	Gray Squirrel	<i>Sciurus carolinensis</i>	G	Ground Forager	Terrestrial Subsurface	X	X	X	X	X	
	Red Squirrel	<i>Tamiasciurus hudsonicus</i>	G	Ground Forager	Tree Cavity-Crevices	X	X	X	X	X	
Soricidae	S. Flying Squirrel	<i>Glaucomys volans</i>	G	Upper Canopy Forager	Tree Cavity-Crevices						
	Woodchuck	<i>Marmota monax</i>	G	Ground Forager	Tree Cavity-Crevices	X	X	X	X	X	
Soricidae	Masked Shrew	<i>Sorex cinereus</i>	H	Ground Grazer	Terrestrial Subsurface		X		X	X	
	N. Short-tailed Shrew	<i>Blarina brevicauda</i>	I	Ground Gleaner	Terrestrial Subsurface	X	X	X	X	X	
Talpidae	Hairy-tailed Mole	<i>Parascalops breweri</i>	I	Ground Gleaner	Terrestrial Subsurface	X	X	X	X	X	
	Star-nosed Mole	<i>Condylura cristata</i>	I	Water Gleaner	Riparian Subsurface	X	X	X	X	X	
Vespertilionidae	Big Brown Bat	<i>Eptesicus fuscus</i>	I	Air Hawker	Buildings	X	X	X	X	X	X

TABLE 8-26 (cont.)
SITE 2 POTENTIAL ECOLOGICAL RECEPTOR SPECIES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

FAMILY	COMMON NAME	SCIENTIFIC NAME	GUILD	FORAGE METHOD	BREEDING SUBSTRATE	HABITAT COVER TYPE					
	Eastern Pipistrelle	<i>Pipistrellus subflavus</i>	I	Air Hawker	Cave-Crevise	A	B	C	D	E	F
	Hoary Bat	<i>Lasiurus cinereus</i>	I	Air Hawker	Tree-Twig	X	X				X
	Little Brown Bat	<i>Myotis lucifugus</i>	I	Air Hawker	Buildings	X	X		X	X	X
	Red Bat	<i>Lasiurus borealis</i>	I	Air Hawker	Tree-Twig						X
	Silver-haired Bat	<i>Lasiorycteris noctivagans</i>	I	Air Hawker	Tree-Twig	X	X		X	X	X
Zapodidae	Meadow Jumping Mouse	<i>Zapus hudsonius</i>	O	Ground Forager	Ground-Herb	X	X				
	Woodland Jumping Mouse	<i>Napaeozapus insignis</i>	O	Ground Forager	Ground-Herb			X	X		
Reptiles											
Chelydridae	Snapping Turtle	<i>Chelydra serpentina</i>	O	Bottom Forager	Riparian Subsurface	X	X		X		X
Colubridae	E. Smooth Green Snake	<i>Ophedrys v. vernalis</i>	I	Ground Ambusher	Terrestrial Subsurface	X	X			X	
	Eastern Garter Snake	<i>Thamnophis s. sirtalis</i>	C	Ground Ambusher	Terrestrial Subsurface	X	X	X	X	X	
	Eastern Milk Snake	<i>Lampropeltis t. triangulum</i>	C	Ground Ambusher	Terrestrial Subsurface	X	X	X	X		
Colubridae	Eastern Ribbon Snake	<i>Thamnophis s. sauritus</i>	C	Water Ambusher	Riparian Subsurface						X
	Northern Black Racer	<i>Coluber c. constrictor</i>	C	Ground Ambusher	Terrestrial Subsurface	X	X	X	X	X	
	Northern Brown Snake	<i>Storeria d. dekayi</i>	I	Ground Ambusher	Terrestrial Subsurface	X	X	X	X	X	
	Northern Redbelly Snake	<i>Storeria o. occipitamaculata</i>	I	Ground Ambusher	Terrestrial Subsurface						
	Northern Ringneck Snake	<i>Diadophis punctatus edwardsi</i>	C	Ground Ambusher	Terrestrial Subsurface						
	Northern Water Snake	<i>Nerodia s. sipedon</i>	C	Ground Ambusher	Terrestrial Subsurface						
	Eastern Box Turtle	<i>Terrapene c. carolina</i>	O	Water Ambusher	Riparian Subsurface		X	X	X	X	X
Emydidae	Eastern Painted Turtle	<i>Chrysemys p. picta</i>	O	Ground Forager	Terrestrial Subsurface	X					X
Kinosternidae	Musk Turtle	<i>Sternotherus odoratus</i>	C	Bottom Forager	Terrestrial Subsurface				X		X
					Riparian Subsurface						X

Guilds:

- C: Carnivore
- F: Frugivore
- G: Granivore
- H: Herbivore
- I: Insectivore
- O: Omnivore
- P: Piscivore

Habitat Cover Types:

- A: Grassland
- B: Old Field/Shrubland
- C: Forested Uplands
- D: Forested Wetlands
- E: Wet Meadow
- F: Pond/Lake

8.2.4 Effects Assessment

Sediment quality criteria guidelines were used in assessing constituents detected in sediment samples. Criteria used in the assessment are described below.

- EPA Interim Sediment Criteria (EPA, 1993) - EPA has derived sediment quality criteria for several PAHs and pesticides. These criteria represent concentrations that may be present in sediments without resulting in adverse effects to benthic organisms. Available criteria were developed by EPA using the equilibrium partitioning (EqP) approach. The EqP approach relates the bioavailable portion of a contaminant within the sediment (i.e. within the interstitial pore water) and effects to benthic organisms. The EqP approach is dependent upon the fraction of organic carbon present in the sediment and the organic carbon normalized partition coefficient (K_{oc}) of a specific contaminant.
- NOAA Sediment Guidelines (Long and Morgan, 1990) - National Oceanic and Atmospheric Administration (NOAA) sediment guidelines were developed from a review of available studies regarding contaminant concentrations and biological effects. These studies included bioassay results, benthic in fauna effects thresholds, and predicted effects from estimated bioavailable contaminant concentrations. These data were sorted and the lower 10th percentile and 50th percentile effect concentrations were identified as the Effects Range-Low (ER-L) and Effects Range-Median (ER-M), respectively.
- MOE Sediment Guidelines (MOE, 1992) - Ontario Ministry of the Environment (MOE) has developed sediment guidelines to assess potential adverse impacts to the macrobenthic community from sediment contaminants. MOE Sediment Guidelines were developed from a review of available freshwater data regarding contaminant concentrations and biological effects. These data were sorted and the Lowest Effects Level (LEL) and Severe Effect Level (SEL) were identified. The LEL represents a concentration which has no effect on the majority of benthic species while the SEL represents a concentration likely to adversely affect most sediment-dwelling organisms. SEL guidelines are normalized to the organic carbon content of a site's sediment using the EqP approach.
- NYSDEC Sediment Guidelines (NYSDEC, 1993) - NYSDEC has developed sediment quality criteria for non-polar organic contaminants using the EqP approach. These criteria include additional contaminants lacking EPA criteria and are based in concentrations resulting in acute/chronic effects to benthic organisms as well as bioaccumulation effects to wildlife. For inorganic compounds, NYSDEC developed criteria using the LEL/SEL nomenclature. The NYSDEC LEL is the lower value of the ER-L and the MOE-LEL. The NYSDEC SEL is the lower value of the ER-M and the MOE-SEL.

Table 8-27 presents these sets of sediment quality criteria. Sediment quality guidelines used for risk characterization of the sediment included all of the above referenced values. However, EPA and NYSDEC values were preferred for organic contaminants (when available) while MOE

TABLE 8-27
SITE 2 SEDIMENT QUALITY GUIDELINES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	ER-L CONC.	ER-M CONC.	LOWEST EFFECT LEVEL	SEVERE EFFECT LEVEL ¹	NYSDEC CRITERIA			U.S. EPA CRITERIA
					WILDLIFE BIOACCUMULATION ¹	BENTHIC		
						AQUATIC LIFE	CHRONIC TOXICITY ¹	
VOCs (µg/kg)								
Total Xylenes	-	-	-	-	-	-	-	-
SVOCs (µg/kg)								
Benzo(a)anthracene	230	1600	220	17200	-	-	-	-
Benzo(a)pyrene	400	2500	370	16700	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	240	15500	-	-	-	-
Benzo(g,h,i)perylene	-	-	170	3700	-	-	-	-
Carbazole	-	-	-	-	-	-	-	-
Chrysene	400	2800	340	5300	-	-	-	-
Dibenz(a,h)anthracene	60	260	60	1500	-	-	-	-
Di-n-butylphthalate	-	-	-	-	-	11832	7192	-
Fluoranthene	600	3600	750	11800	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	200	3700	-	-	-	-
Phenanthrene	225	1380	560	11000	-	1392	2088	-
Pyrene	350	2200	490	9860	-	-	-	-
PEST/PCBs (µg/kg)								
4,4'-DDD	2	20	8	69.6	11.6	-	-	-
4,4'-DDE	2	15	5	220.4	11.6	-	-	-
4,4'-DDT	1	7	7	823.6	11.6	11.6	11.6	-
Dieldrin	0.02	8	2	1055.6	-	104	127.6	-
Inorganics (mg/kg)								
Aluminum	-	-	-	-	- ²	- ²	- ²	-
Arsenic	33	85	6	33	-	-	-	-
Barium	-	-	-	-	-	-	-	-
Beryllium	-	-	-	-	-	-	-	-
Chromium	80	145	26	110	-	-	-	-
Cobalt	-	-	-	-	-	-	-	-
Copper	70	380	16	110	-	-	-	-
Iron	-	-	2(%)	4(%)	-	-	-	-
Lead	35	110	31	250	-	-	-	-
Magnesium	-	-	-	-	-	-	-	-
Manganese	-	-	460	1100	-	-	-	-
Mercury	0.15	1.3	0.2	2	-	-	-	-
Nickel	30	50	16	75	-	-	-	-
Potassium	-	-	-	-	-	-	-	-
Silver	1	2.2	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-
Zinc	120	270	120	820	-	-	-	-

ABBREVIATIONS
4,4'-DDD - Dichlorodiphenyldichlorethane
4,4'-DDE - Dichlorodiphenyldichlorethylene
4,4'-DDT - Dichlorodiphenyltrichlorethane
NYSDEC - New York State Department of Conservation
mg/kg - milligrams per kilogram
SVOCs - Semi-Volatile Organic Compounds
TOC - Total Organic Carbon
VOCs - Volatile Organic Compounds
µg/kg - micrograms per kilogram
- not available

NOTES
1) Criteria for SVOCs and Pesticides/PCBs were converted to bulk sediment values by multiplying by the TOC concentration of the sediments.
2) NYSDC uses the lowest level of risk for metals contamination of sediment as established by MOE or NOAA Sediment Guidelines. These Guidelines were also used to develop the ER-L, ER-M, Lowest Effect Level and Severe Effect Level criteria listed in this table.

values were preferred for inorganics and remaining organic contaminants. All positive detections in sediment samples are listed in Table 6-15. Table 8-28 presents all exceedances of sediment criteria guidelines. Background concentrations are also included in Table 8-28 for comparison.

8.2.5 Risk Characterization

Concentrations above the sediment quality guidelines were detected in several samples. Reported detections of the different analyte types are discussed below:

VOCs -- Sediment quality guidelines are not available for xylene, which is the only VOC contaminant detected.

SVOCs -- One SVOC, benzo(g,h,i)perylene, was encountered above sediment quality guidelines in one sample, SS-04. The sample was taken from the culvert outwash area which receives parking lot runoff from the auto maintenance facility. Benzo(g,h,i)perylene is a PAH that commonly occurs at such facilities. Because this contaminant was not encountered at other points along the drainage path it can reasonably be assumed that the source of benzo(g,h,i)perylene is the parking lot rather than Site 2.

Pesticides - Concentrations of DDT and DDE above sediment quality guidelines were encountered in SS-04 and SS-06. These exceedances were between one and four times their applicable sediment criteria guidelines. However, these pesticides are ubiquitous in surficial soil and sediment samples throughout the site.

Metals -- Concentrations of copper, iron, manganese and nickel exceeded sediment quality guidelines. However, the concentrations of all metals except manganese were within the range of or below background levels for the site. The manganese concentrations detected at SS-05 and SS-15 were approximately twice the LEL.

In summary, concentrations of one PAH, two pesticides and manganese exceeded applicable sediment criteria guidelines and background levels used as screening values for sediment. These criteria guidelines were developed for the protection of benthic organisms inhabiting aquatic environments. However, in general, this site does not provide valuable aquatic habitat due to the intermittent nature of the storm water discharges within the drainage ditches. Risks to potential aquatic receptors are likely to be more limited by the poor habitat quality available to benthic organisms than contaminant concentrations. It should be noted that all concentrations detected in sediment samples were well below TAGM cleanup criteria for soil.

TABLE 8-28
SITE 2 SEDIMENT SAMPLE EXCEEDANCES
STEWART AIR NATIONAL GUARD BASE
NEWBURGH, NEW YORK

ANALYTE	DETECTION LIMITS ¹	SITE 2 BKGRND. CONC.	LOWEST EFFECT LEVEL ²	SS-02	SS-04	SS-05	SS-06	SS-07	SS-15
SVOCs (µg/kg)									
Benzo(g,h,i)perylene	330	NA	170	360 U	210 J	400 U	390 U	380 U	410 U
PEST/PCBs (µg/kg)									
4,4'-DDE	3.3	NA	5	2.6	18	2.1	9.4	4.4 J	1.9 J
4,4'-DDT	3.3	NA	8	2.1 J	36	0.59 R	16	1.4 J	0.29 R
Dieldrin	3.3	NA	2	2.5 J	86	5.6	5.7 J	1.3 R	4.3 J
Inorganics (mg/kg)									
Aluminum	40	12,500	-	10000	11200	11900	10300	14100	13400
Copper	5	24.2	16	19.9	15.5	24.8	22	14.1	27.7
Iron	20	23,400	2(%)	22200	19500	23600	21500	19600	26600
Manganese	3	672	460	566	724	1240	647	753	1170
Nickel	8	28.6	16	21.5	17.1	21.1	22.4	17.4	26.3
Potassium	1000	636	-	632	624	909	950	654	1020
Silver	2	0.5	1	0.82 U	0.67	0.9 U	0.46	0.51	0.93 U
Thallium	2	0.13	-	0.13 UJ	0.14 UJ	0.17 J	0.14 UJ	0.6 J	0.15 UJ
Vanadium	10	17.5	-	13.5	17.6	16	14.3	17.2	17.7
Zinc	4	61.4	120	64.3	60.7	95.5	61.7	57.7	76.9

ABBREVIATIONS

4,4'-DDD - Dichlorodiphenyldichloroethane
4,4'-DDE - Dichlorodiphenyldichloroethylene
4,4'-DDT - Dichlorodiphenyltrichloroethane
mg/kg - milligrams per kilogram
ND - Not Detected

NYSDEC - New York State Department of Environmental Conservation
PEST/PCBs - Pesticides/Polychlorinated Biphenyls
SVOCs - Semi-Volatile Organic Compounds
VOCs - Volatile Organic Compounds
µg/kg - micrograms per kilogram
- not available

NOTES

- 1) Detection Limits - Contract Required Detection Limits for Organics
- Contract Required Quantitation Limits for Inorganics
- 2) NYSDEC Sediment Criteria, November 1993

5.2

- Indicates Concentration exceeds Lowest Effect Level

SECTION 9.0

9.0 CONCLUSIONS

1. Contamination Nature and Extent

At Site 2, the nature and extent of residual contamination in each of the media sampled were as follows:

Surface Soils: Surface soils were generally free of significant contamination. The compounds exceeding site background or NYSDEC Cleanup Goals were manganese and chromium. No surface soil samples contained pesticide concentrations greater than their respective NYSDEC Cleanup Goals. Upon completion of the construction of a NYSDEC Part 360 cover over the adjacent landfill, exposure to surface soils containing elevated levels of manganese and chromium will be prevented.

Subsurface Soils: The lateral extent of residual pesticide contamination within subsurface soils was well defined to the north, south, and west of the PPBA. The bulk of residual subsurface soil contamination appears to be present approximately 15 to 25 feet bgs in the vicinity of soil boring MW-02. Several inorganic analytes were detected at concentrations greater than their respective background or NYSDEC Cleanup Goals. The majority of these detections were found at the overburden/bedrock interface in soil borings SB-06 and MW-02. No discernible pattern of elevated concentrations of inorganic analytes was found in subsurface soils. Again, upon construction of the adjacent landfill cover, exposure to subsurface soils will be prevented.

Sediments: Every sediment sample contained low levels of pesticides. Exceedances of NYSDEC Cleanup Goals were found only in samples SS-04 and SS-06, in the vicinity of the ponded area. Inorganic analytes exceeding NYSDEC Cleanup Goals were found in several samples, but the highest levels were found in SS-05, located within the ponded area.

Groundwater: Groundwater in the vicinity of Site 2 is generally free of significant VOC and SVOC contamination; however, pesticides were detected in all groundwater samples, thus exceeding the State drinking water pesticide standard which requires the presence of no detectable level. Therefore, the full extent of pesticide contamination in groundwater has not been defined. In addition, several inorganic compounds were detected at concentrations greater than drinking water standards. However, due to the absence of site-specific background data for inorganics, it is not possible to determine if these detections are actually elevated or if they are representative of site background concentrations.

2. Contaminant Fate And Transport

The primary organic contaminants of interest, the pesticides 4,4'-DDT, 4,4'-DDE and

4,4'-DDD, have very low solubilities, very high sorption potential and high retardation factors. Adsorption to organic material and fines in the overburden appear to play a major role in inhibiting pesticide migration from the source area. DDT was usually prepared in two liquid forms, an emulsion in water or as a solute in acetone, kerosene or fuel oil. In such a form, the pesticide and its liquid carrier would not have migrated any substantial distance from the pesticide pit in its pure form, due to the density and fine-grained nature of the lodgement till soils. Because there is no evidence of any residual LNAPL in the overburden or the bedrock in the vicinity of the Site 2, it is likely that any carrier solvent has volatilized, biodegraded or dissolved to nearly undetectable levels, a scenario which is supported by the presence of low levels of petroleum-related compounds in groundwater in the vicinity of Site 2.

3. Human Health Risk Evaluation

The only exposure scenario with unacceptable risks is the future residential scenario. The hazard index for future on-site residents is 23, almost all of which is attributable to groundwater (hazard index = 23). The breakdown of the cancer risks is similar. Cancer risks for the on-site worker (5×10^{-6}), construction worker (3×10^{-6}), and area resident (2×10^{-6}) are all within the EPA target range of 1×10^{-4} to 1×10^{-6} . The cancer risk for the future on-site resident is 2×10^{-3} , almost all of which is attributable to ingestion of and dermal contact to groundwater.

A number of extremely conservative exposure assumptions were used throughout the risk assessment process. For example, based on current plans for the Base, and the availability of city water to the area, it is highly unlikely that Site 2 will be used for residential purposes, and even more unlikely that a drinking water well would be located at the site. In addition, all exposure point concentrations and risk estimates were derived using values which tended to be conservative. Therefore, it is likely that the risks are highly overestimated and that actual site risks would be much lower.

4. Ecological Risk Evaluation

The ecological risk characterization indicates that of the analytes detected in sediment samples, the PAH benzo(g,h,i)perylene, the pesticides DDT and DDE, and manganese, exceeded applicable sediment criteria guidelines and background levels used as screening values for sediment. These criteria guidelines were developed for the protection of benthic organisms inhabiting aquatic environments; however the site environment does not provide valuable aquatic habitat, due to the intermittent nature of storm water discharges within the drainage ditches. Therefore, the ecological risks caused by these substances is considered less significant than the poor quality of the habitat itself. It should be noted that all concentrations detected in sediment samples were well below TAGM cleanup criteria for soil.

SECTION 10.0

10.0 RECOMMENDATIONS

No further action is recommended at Site 2, because of the fact that the unacceptable risks associated with detected contaminants are attributable only to a future residential scenario that is highly unlikely given the current and planned future uses of the area. Site 2 is located less than 100 feet from Site 1, the former Base landfill, which is scheduled to be capped in the fall of 1997. The deed restrictions associated with the landfill cap will effectively prevent future residential use of Site 2, thus mitigating any potential risk associated with future use of Site 2.

SECTION 11.0

11.0 REFERENCES

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